Amendment to the Drawing

       The attached sheets of Drawings includes Amendments to Figures 2-12. As requested by the Examiner, original Figures 2 and 4 were removed from the Drawing and are now included in the specification as Appendices G and H, respectively. The remaining Figures 3 and 5-12 were renumbered as Figures 2-10, so that figures are continuously numbered.

Attachment: Replacement Sheets

Remarks

Claims 50-69 and 82-106 are pending in the application. Claims 53, 54, 57, and 58 have been withdrawn from consideration by the Examiner. Claims 50-52, 55, 56, 59-69, and 82-106 are rejected by the Examiner.

Claims 50-95 have been canceled. Claims 96, 97, 100, 101, 104, 105, and 106 have been amended, and new claim 107 has been added. Support for amended claim 96 and new claim 107 can be found in the specification in paragraphs 46, 48, and 96 and in Example 1. Claims 97, 105, and 106 have been amended to correct the dependencies of those claims. Claims 100 and 101 were amended to correct the numbering within those claims.

Applicant submits that no new matter has been added by the present Amendment. Applicant specifically reserves the right to pursue the subject matter of the original and previously presented claims in a related application; the present Amendment is introduced for the *sole* purpose of focusing the issues in this case and speeding its progress toward allowance. Applicant respectfully requests reexamination and reconsideration of the present case, as amended. Each of the rejections levied in the Office Action is addressed individually below.

I.   Objection to the specification. The Examiner has objected to the disclosure because pages 31 and 33-35 disclose nucleic acid sequences, but do not disclose embedded sequence identifiers (*e.g.*, "SEQ ID NO:") as required by 37 C.F.R. § 1.821(d). As requested by the Examiner, Applicant has amended the specification to include embedded sequence identifiers. Applicant, therefore, respectfully requests that the rejection be removed.

The Examiner has further objected to the disclosure because it contains an embedded hyperlink and/or other form of browser-executable code. As requested by the Examiner, Applicant has amended the specification to remove the hyperlink. Applicant, therefore, respectfully requests that the objection be removed.

The Examiner has further objected to the Drawing, and this objection is addressed in more detail below. However, the Amendment to the Drawing has necessitated Amendments to the specification. As requested by the Examiner, original Figures 2 and 4 were removed from the Drawing and are now included in the Specification as Appendices G and H, respectively. The remaining original Figures 3 and 5-12 were renumbered as Figures 2-10, so that figures remain continuously numbered. The specification was Amended to correct the numbering of figures throughout the specification.

II.   Objection to the drawing. The Examiner has objected to Figures 2 and 4. In particular, the Examiner states that Figures 2 and 4 are merely text lists of viral genes or components, and that they should be moved into the specification as tables and deleted as figures. Furthermore, the Examiner states that the remaining figures should be amended so that their numbering is continuous.

As requested by the Examiner, Applicant has amended the Drawing to remove Figures 2 and 4 and renumbered the remaining figures. In addition, Applicant has amended the specification to remove the legends to Figures 2 and 4 and to renumber the legends to the remaining figures. Furthermore Applicant has amended the specification to include Appendices G and H, which correspond to original Figures 2 and 4. Finally, Applicant has amended the specification to correct all references to figure numbers. Applicant, therefore, respectfully requests that the objection be removed.

III.   Rejection under 35 U.S.C. § 102(b) as being anticipated by Spitsin *et al.* (*Proc. Natl. Acad. Sci., USA*, 96: 2549-53, 1999). Claims 50-52, 55, 56, 59-69, 84, and 85 are rejected under 35 U.S.C. § 102(b) as being anticipated by Spitsin *et al.* (*Proc. Natl. Acad. Sci., USA*, 96: 2549-53, 1999). The Examiner states that Spitsin *et al.* teaches a vector in which the full-length cDNA of the RNA4 gene has been substituted into a tobacco mosaic virus vector. Thus, the Examiner states that the vector of Spitsin *et al.* anticipates the present claims. Claims 1-95 have been canceled by the present Amendment; therefore, Applicant respectfully submits that the rejection is rendered moot by the present Amendment.

IV.   Rejection under 35 U.S.C. § 102(e) as being anticipated by Zhu *et al.* (U.S. Patent No. 6,858,426). Claims 50, 55, 56, 66, 68, and 86 are rejected under 35 U.S.C. § 102(e) as being anticipated by Zhu *et al.* (U.S. Patent No. 6,858,426). The Examiner states that embodiments outside of the elected species were discovered in the search for the elected species. In particular, the Examiner states that Zhu *et al.* teaches a viral vector comprising portions of several plant viruses, specifically the cauliflower mosaic virus (CaMV) 35S enhancer and promoter, the alfalfa mosaic virus RNA4 leader sequence, the Grapevine leafroll virus (type 2) coat protein gene, and the CaMV 35S 3' untranslated region. Thus, the Examiner states that the viral vector of Zhu *et al.* anticipates the present claims. Claims 1-95 have been canceled by the present Amendment; therefore, Applicant respectfully submits that the rejection is rendered moot by the present Amendment.

V. **Rejection under 35 U.S.C. § 112, first paragraph.** Claims 50-52, 55, 56, 59-69, and 82-106 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular, the Examiner uses two references to suggest that "the mere presence of expressed components of a virus together is not sufficient to predict function, given any sort of change or mutation." Thus, the Examiner argues, in the case of substituting one viral component for another, there can be no prediction of the ability of the new component to associate functionally with a second component of the original virus. The Examiner, therefore, concludes that the Applicant was not in possession of the full scope of the claimed invention at the time of filing. Applicant respectfully disagrees.

Applicant submits that the present specification demonstrates that (1) components of two different viruses (tobacco mosaic virus and alfalfa mosaic virus) are able to substitute for one another and can associate functionally with other viral components; and (2) such a system is able to successfully produce a desired protein. Furthermore, detailed methods for testing the ability of any viral components to be substituted for one another are described throughout the entire specification and are described further and demonstrated in the Examples; thus, Applicant submits that such methods are a matter of routine experimentation. Applicant reduces the invention to practice and describes methods by which any viral components can be tested for utility in accordance with the present invention. Applicant, therefore, respectfully submits that Applicant was in possession of the full scope of the claimed invention at the time of filing.

However, solely in order to further prosecution, Applicant has amended claim 96 to recite "tobacco mosaic virus" instead of "plant virus," and has added new claim 107, which recites "alfalfa mosaic virus." As discussed above, Applicant has clearly demonstrated that components of tobacco mosaic virus and alfalfa mosaic virus are able to substitute for one another and can associate functionally with other viral components in accordance with the present invention. Applicant, therefore, requests that this rejection be removed.

VI. **Rejection under 35 U.S.C. § 112, second paragraph.** Claims 94, 95, and 104 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to point out and distinctly claim the subject matter which Applicant regards as the invention. In particular, the Examiner states that there is insufficient antecedent basis for the phrase "the first and second polypeptides" in claims 94 and 95. Claims 94 and 95 are canceled by the present Amendment;

therefore, Applicant respectfully submits that the rejection is rendered moot by the present Amendment.

The Examiner further states that the phrase, "proteins of pharmaceutical interest" in claims 95 and 104 is indefinite because it is not clear what this phrase means. Thus, claim 104 has been amended to recite, "therapeutically active proteins," as stated in paragraph 61 of the specification. Applicant submits that "therapeutically active proteins" in accordance with the present invention may include any of the proteins described in paragraphs 59-66 of the specification. Applicant, therefore, respectfully requests that the rejection be removed.

Applicant therefore respectfully submits that the present case is in condition for allowance. A Notice to that effect is respectfully requested.

If, at any time, it appears that a phone discussion would be helpful, the undersigned would greatly appreciate the opportunity to discuss such issues at the Examiner's convenience. The undersigned can be contacted at (617) 248-5000.

Please charge any fees that may be required for the processing of this Response, or credit any overpayments, to our Deposit Account No. 03-1721.

Respectfully submitted,

Cameron M. Luitjens, Ph.D.
Registration Number: 58,674

Choate, Hall & Stewart LLP
Two International Place
Boston, MA 02110
t (617) 248-5000
f (617) 248-4000
cluitjens@choate.com

Date: March 12, 2007

DNA Viruses

Circular dsDNA Viruses

- ◈ Family: _Caulimoviridae_

    - ◈ Genus: _Badnavirus_

        Type species: commelina yellow mottle virus

    - ◈ Genus: _Caulimovirus_

        Type species: cauliflower mosaic virus

    - ◈ Genus "SbCMV-like viruses"

        Type species: Soybean chloroticmottle virus

    - ◈ Genus "CsVMV-like viruses"

        Type species: Cassava vein mosaicvirus

    - ◈ Genus "RTBV-like viruses"

        Type species: Rice tungro bacilliformvirus

    - ◈ Genus: "Petunia vein clearing-like viruses"

        Type species: _Petunia vein clearing virus_

Circular ssDNA Viruses

- ◈ Family: _Geminiviridae_

    - ◈ Genus: _Mastrevirus (Subgroup I Geminivirus)_

        Type species: maize streak virus

◈ Genus: _Curtovirus (Subgroup II Geminivirus)_

Type species: beet curly top virus

◈ Genus: _Begomovirus (Subgroup III Geminivirus)_

Type species: bean golden mosaic virus

RNA Viruses

ssRNA Viruses

◈ Family: _Bromoviridae_

    ◈ Genus: _Alfamovirus_

    Type species: alfalfa mosaic virus

    ◈ Genus: _Ilarvirus_
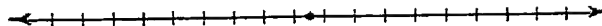
    Type species: tobacco streak virus

    ◈ Genus: _Bromovirus_

    Type species: brome mosaic virus

    ◈ Genus: _Cucumovirus_

    Type species: cucumber mosaic virus

◈ Family: _Closteroviridae_

    ◈ Genus: _Closterovirus_

    Type species: beet yellows virus

    ◈ Genus: _Crinivirus_

    Type species: Lettuce infectious yellows virus

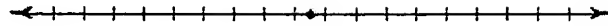◆ Family: *Comoviridae*

    ◆ Genus: *Comovirus*

    Type species: cowpea mosaic virus

    ◆ Genus: *Fabavirus*

    Type species: broad bean wilt virus 1

    ◆ Genus: *Nepovirus*

    Type species: tobacco ringspot virus

        ←—+—+—+—+—+—+—+—•+—+—+—+—+—+—+—→

◆ Family: *Potyviridae*

    ◆ Genus: *Potyvirus*

    Type species: potato virus Y

    ◆ Genus: *Rymovirus*

    Type species: ryegrass mosaic virus

    ◆ Genus: *Bymovirus*

    Type species: barley yellow mosaic virus

        ←—+—+—+—+—+—+—+—•+—+—+—+—+—+—+—→

◆ Family: *Sequiviridae*

    ◆ Genus: *Sequivirus*

    Type species: parsnip yellow fleck virus

    ◆ Genus: *Waikavirus*

    Type species: rice tungro spherical virus

        ←—+—+—+—+—+—+—+—•+—+—+—+—+—+—+—→

- Family: *Tombusviridae*
  - Genus: *Carmovirus*

    Type species: carnation mottle virus

  - Genus: *Dianthovirus*

    Type species: carnation ringspot virus

  - Genus: *Machlomovirus*
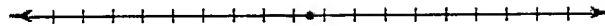
    Type species: maize chlorotic mottle virus

  - Genus: *Necrovirus*

    Type species: tobacco necrosis virus

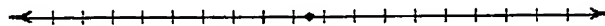 - Genus: *Tombusvirus*

    Type species: tomato bushy stunt virus

- Unassigned Genera of ssRNA viruses
  - Genus: *Capillovirus*
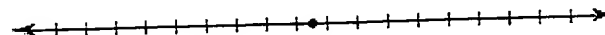
    Type species: apple stem grooving virus

  - Genus: *Carlavirus*

    Type species: carnation latent virus
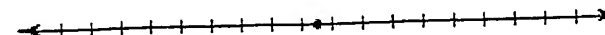
  - Genus: *Enamovirus*
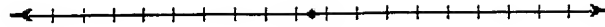
    Type species: pea enation mosaic virus

  - Genus: *Furovirus*

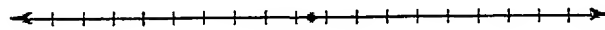   *Type species:* soil-borne wheat mosaic virus

◆ Genus: *Hordeivirus*
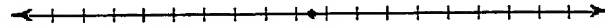
    Type species: barley stripe mosaic virus

               ◄━┼━┼━┼━┼━┼━┼━┼●┼━┼━┼━┼━┼━┼━►

◆ Genus: *Idaeovirus*

    Type species: raspberry bushy dwarf virus

               ◄━┼━┼━┼━┼━┼━┼●┼━┼━┼━┼━┼━►

◆ Genus: *Luteovirus*

    Type species: barley yellow dwarf virus

               ◄━┼━┼━┼━┼━┼━┼━●┼━┼━┼━┼━┼━┼━►

◆ Genus: *Marafivirus*

    Type species: maize rayado fino virus

               ◄━┼━┼━┼━┼━┼━┼━●┼━┼━┼━┼━┼━┼━►
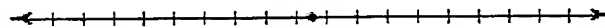
◆ Genus: *Potexvirus*

    Type species: potato virus X

               ◄━┼━┼━┼━┼━┼━┼●┼━┼━┼━┼━┼━┼━►
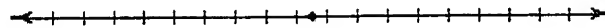
◆ Genus: *Sobemovirus*

    Type species: Southern bean mosaic virus

               ◄━┼━┼━┼━┼━┼━┼●┼━┼━┼━┼━┼━┼━►
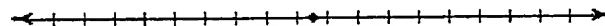
◆ Genus: *Tenuivirus*

    Type species: rice stripe virus

               ◄━┼━┼━┼━┼━┼━┼━●┼━┼━┼━┼━┼━┼━►
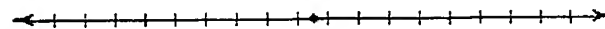
◆ Genus: *Tobamovirus*

    Type species: tobacco mosaic virus

                    ◄━┼━┼━┼━┼━┼━┼━●┼━┼━┼━┼━┼━┼━►
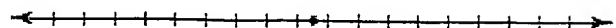
◆ Genus: *Tobravirus*

  Type species: tobacco rattle virus

<----+--+--+--+--+--+--+--•+--+--+--+--+--+--+--+--+--+-->
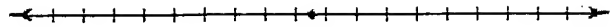
◆ Genus: *Trichovirus*

  Type species: apple chlorotic leaf spot virus

<----+--+--+--+--+--+--+--•+--+--+--+--+--+--+--+-->
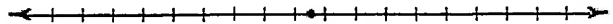
◆ Genus: *Tymovirus*

  Type species: turnip yellow mosaic virus

<----+--+--+--+--+--+--•+--+--+--+--+--+--+--+-->

◆ Genus: *Umbravirus*

  Type species: carrot mottle virus

<----+--+--+--+--+--+--•+--+--+--+--+--+--+--+-->

Negative ssRNA Viruses

◆ Order: *Mononegavirales*
  ◆ Family: *Rhabdoviridae*

    ◆ Genus *Cytorhabdovirus*

      Type Species lettuce necrotic yellows virus

    ◆ Genus: *Nucleorhabdovirus*

      Type species: potato yellow dwarf virus

<----+--+--+--+--+--+--•+--+--+--+--+--+--+--+-->

Negative ssRNA Viruses

◆ Family: *Bunyaviridae*

    ◆ Genus: *Tospovirus*

      Type species: tomato spotted wilt virus

dsRNA Viruses
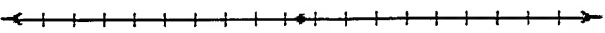
◆ Family: *Partitiviridae*

    ◆ Genus: *Alphacryptovirus*

        Type species: white clover cryptic virus 1

    ◆ Genus: *Betacryptovirus*

        Type species: white clover cryptic virus 2

◆ Family: *Reoviridae*

    ◆ Genus: *Fijivirus*

        Type species: Fiji disease virus

    ◆ Genus: *Phytoreovirus*

        Type species: wound tumor virus

    ◆ Genus: *Oryzavirus*

        Type species: rice ragged stunt virus

Unassigned Viruses

    ◆ Genome *ssDNA*
        ◆ Species banana bunchy top virus
        ◆ Species coconut foliar decay virus
        ◆ Species subterranean clover stunt virus
    ◆ Genome *dsDNA*
        ◆ Species cucumber vein yellowing virus
    ◆ Genome *dsRNA*
        ◆ Species tobacco stunt virus
    ◆ Genome *ssRNA*
        ◆ Species Garlic viruses A,B,C,D
        ◆ Species grapevine fleck virus
        ◆ Species maize white line mosaic virus
        ◆ Species olive latent virus 2
        ◆ Species ourmia melon virus
        ◆ Species Pelargonium zonate spot virus
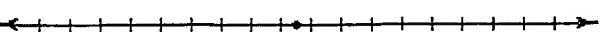
Satellites and Viroids

- Satellites
  - ssRNA Satellite Viruses
    - Subgroup 2 Satellite Viruses

      Type species: tobacco necrosis satellite

      <----|--|--|--|--|--|--|--|-•-|--|--|--|--|--|--|---->
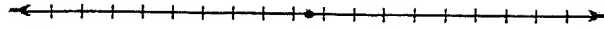
  - *Satellite RNA*
    - Subgroup 2 *B Type mRNA Satellites*
    - Subgroup 3 *C Type linear RNA Satellites*
    - Subgroup 4 *D Type circular RNA Satellites*

      <----|--|--|--|--|--|--|--|-•-|--|--|--|--|--|--|---->
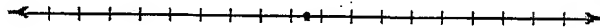
- *Viroids*

  Type species: potato spindle tuber viroid

  <----|--|--|--|--|--|--|--|-•-|--|--|--|--|--|--|---->
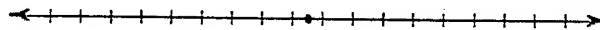
Tobamovirus Helicase

```
          1
TMV-KR    KQMSSIVYTGPIKVQQMKNFIDSLVASLSAAVSNLVKILKDTAAIDLETR
TMV-RAK   KQMSSIVYTGPIKVQQMKNFIDSLVASLSAAVSNLVKILKDTAAIDLETR
TMV-vul   KQMSSIVYTGPIKVQQMKNFIDSLVASLSAAVSNLVKILKDTAAIDLETR
TOMV      KQMCSIVYTGPLKVQQMKNFIDSLVASLSAAVSNLVKILKDTAAIDLETR
PMMV      KQMHAMVYTGPLKVQQCKNYLDSLVASLSAAVSNLKKIIKDTAAIDLETK
TMGMV     KQMASVVYTGSLKVQQMKNYVDSLAASLSATVSNLCKSLKDEVGYDSDSR
TMV-OB    NKMASIVYSGPLQVQQMQNYVDSLAASLSATVSNLKKLVKDSSVGFQDSL
ORSV      KSMSSAVYTGPLKVQQMKNYMDYLSASISATVSNLCKVLKDVYGVDPESA
TVCV      GTMMSAVYTGSIKVQQMKNYIDYLSASLAATVSNLCKVLRDVHGVDPESQ
CR-TMV    GTMMSAVYTGSIEVRQMKNYIDYLSASLSATVSNLCKVLRDVHGVDPESQ
RMV-SH    GAMMSAVYTGKIKVQQMKNYVDYLSASLSATVSNLCKVLRDVHGVDPESQ
CRMV      GAMMSAVYTGKIKVQQMKNYVDYLSASLSATVSNLCKVLRDVHGVDPESQ
TMV-CG    GAMMSAVYTGKIKVQQMKNYVDYLSASLSATVSNLCKVLRDVHGVDSESQ
CGMMV     KTITPVVYTGTIREROMKNYIDYLSASLGSTLGNLERIVRSDWNGTEESM
CGMMV-W   KTITPVVYTGTIREROMKNYIDYLSASLGSTLGNLERIVRSDWNGTEESM
CFMMV     KTITPVIYTGPIRVRQMANYLDYLSANLAATIGILERIVRSNWSGN-EVV
YCGMMV    KSITPVIYTGPIRVRQMANYLDYLSASLTATIGNLERIVSSSWTGENELV
SHMV      QKPVNIVYTGEVQICQMQNYLDYLSASLVACISNLKKYLQDQWLNPGEKF

          51
TMV KR      QKFGVLDVASRKWLIKPTAKSHAWGVVETHARKYHVALLEYDE-QGVVTC
TMV-RAK     QKFGVLDVASRKWLIKPTAKSHAWGVVETHARKYHVALLEYDE-QGIVTC
P03586 TMV  QKFGVLDVASRKWLIKPTAKSHAWGVVETHARKYHVALLEYDE-QGVVTC
TOMV        QKFGVLDVASKRWLVKPSAKNHAWGVVETHARKYHVALLEHDE-FGIITC
PPMV        EKFGVYDVCLKKWLVKPLSKGHAWGVVMDSDYKCFVALLTYDG-ENIVCG
TMGMV       EKVGVWDVTLKKWLLKPAAKGHSWGVVLDYKGKMFTALLSYEG-DRMVTE
TMV OB      SKVGVFDVRKKMWLIKPTLKNHSWGVVQKFDGKCFLALLSYHN-ELPICD
ORSV .      EKSGVYDVVKGKWIIKPKDKCHAWGVADLNNGEKVIVLLEWAD-GFPIC-
TVCV        EKSGVWDVRRGRWLLKPNAKSHAWGVAEDANHKLVIVLLNWDD-GKPVCD
CR-TMV      EKSGVWDVRRGRWLLKPNAKSHAWGVAEDANHKLVIVLLNWDD-GKPVCD
RMV-SH      EKSGVWDVRRGRWLLKPNAKCHAWGVAEDANHKLVIVLLNWDE-GNPVCD
CRMV        EKSGVWDVRRGRWLLKPNAKCHAWGVAEDANHKLVIVLLNWDE-GKPVCD
TMV-CG      EKSGVWDVRRGRWLLKPNAKCHAWGVAEDANHKLVIVLLNWDE-GKPVCD
CGMMV       QTFGLYDCEKCKWLLLPAEKKHAWAVVLASDDTTRIIFLSYDESGSPIID
CGMMV-W     QTFGLYDCEKCKWLLLPAEKKHAWAVVLASDDTTRIIFLSYDESGSPIID
CFMMV       QTYGLFDCQANKWILLPSEKTHSWGVCLTMDDKLRVVLLQYDSAGWPIVD
YCGMMV      QTYGLFDCQADKWILQPTERTHSWGVCLTMDDKLRIVLLQYDEFDWPIVD
SHMV        QKIGVWDNLNNKWIVVPQKKKYAWGLAADVDGNQKTVILNYDEHGMPILE

          101
TMV KR      -DNWRRVAVSSESVVYSDMAKLRTLRRLLRNGEPHVSSAKVVLVDGVPGC
TMV-RAK     -DDWRRVAVSSESVVYSDMAKLRTLRRLLRDGEPHVSNAKVVLVDGVPGC
P03586 TMV  -DDWRRVAVSSESVVYSDMAKLRTLRRLLRNGEPHVSSAKVVLVDGVPGC
TOMV        -DNWRRVAVSSESVVYSDMAKLRTLRRLLKDGEPHVSSAKVVLVDGVPGC
PPMV        -ETWRRVAVSSESLVYSDMGKIRAIRSVLKDGEPHISSAKVTLVDGVPGC
TMGMV       -SDWRRVAVSSDTMVYSDIAKLQNLRKTMRDGEPHEPTAKMVLVDGVPGC
TMV OB      -ADWSKVAVSNESMVYSDMAKLRVLRKSIGEMPISVSSAKVTLVDGVPGC
ORSV        -GDWRRVAVSSDSLIYSDMGKLQTLLRCLKDGEPVLRMPKVTLVDGVLGC
TVCV        -ETWFRVAVSSDSLIYSDMGKLKTLTSCSPNGEPPEPNAKVILVDGVPGC
CR-TMV      -ETWFRVAVSSDSLIYSDMGKLKTLTTCSPNGEPPEPNAKVILVDGVPGC
RMV-SH      -ETWFRLAVSSDSLVYSDMGKLKTLTACCRDGEPPEPTAKVVLVDGVPGC
CRMV        -ETWFRLAVSSDSLVYSDMGKLKTLTSCCRDGEPPEPTAKLVLVDGVPGC
TMV-CG      -ETWFRLAVSSDSLVYSDMGKLKTLTACCRDGEPPEPTAKVVLVDGVPGC
CGMMV       KKNWKRFAVCSETKVYSVIRSLEVLNKE----AIVDPGVHITLVDGVPGC
CGMMV-W     KKNWKRFAVCSETKVYSVIRSLEVLNKE----AIVDPGVHITLVDGVPGC
CFMMV       KSFWKAFCVCADTKVFSVIRSLEVLSAL----PLVEPDAKYVLIDGVPGC
YCGMMV      KSSWKAFCVSADTKVFSIIRSLEVLSSL----PLSDPTAKFTLIDGVPGC
SHMV        -KSYVRLVVSTDTYLFTVVSMLGYLRHL----DQKKPTATITLVDGVPGC

          151
```

```
TMV KR      GKTKEILSRVNFDEDLILVP( AAEMIRRRANS-SGIIVATKDNVKTVD
TMV-RAK     GKTKEILSRVNFDEDLILVPGKQAAEMIRRRANS-SGIIVATKDNVRTVD
P03586 TMVGKTKEILSRVNFDEDLILVPGKQAAEMIRRRANS-SGIIVATKDNVKTVD
TOMV        GKTKEILSRVNFEEDLILVPGRQAAEMIRRRANA-SGIIVATKDNVRTVD
PPMV        GKTKEILSRVNFDEDLVLVPGKQAAEMIRRRANS-SGLIVATKENVRTVD
TMGMV       GKYGDFERFDLDEDLILVPGKQAAAMIRRRANS-SGLIRATMDNVRTVD
TMV OB      GKTKEILRRVNFSEDLVLVPGKEAAAMIRKRANQ-SGNIVANNDNVKTVD
ORSV        GKTKEILETVNFDEELILVPGKEACKMIIKRANK-SGHVRATKDNVRTVD
TVCV        GKTKEIIEKVNFSEDLILVPGKEASKMIIRRANQ-AGVIRADKDNVRTVD
CR-TMV      GKTKEIIEKVNFSEDLILVPGKEASKMIIRRANH-AGVIRADKDNVSTVD
RMV-SH      GKTKEILEKVNFSEDLVLVPGKEASKMIIRRANQ-AGVTRADKDNVRTVD
CRMV        GKTKEILEKVNFSEDLVLVPGKEASKMIIRRANQ-AGITRADKDNVRTVD
TMV-CG      GKTKEILEKVNFSEDLVLVPGKEASKMIIRRANQ-AGIIRADKDNVRTVD
CGMMV       GKTAEIIARVNWKTDLVLTPGREAAAMIRRRACALHKSPVATNDNVRTFD
CGMMV-W     GKTAEIIARVNWKTDLVLTPGREAAAMIRRRACALHKSPVATNDNVRTFD
CFMMV       GKTQEIISSADFKTDLILTPGKEAAAMIRRRANMKYRSPVATNDNVRTFD
YCGMMV      GKTQEIINSADFKTDLILTPGKESAAMIRRRANAKFRGCVATNDNVRTFD
SHMV        GKTQEILSRFDANSDLILVQGREACEMIRRRAND-NVPGSATKENVRTFD


            201
TMV KR      SFMMNFGKSTRCQFKRLFIDEGLMLHTGCVNFLVTMSLCEIAYVYGDTQQ
TMV-RAK     SFMMNFGKTTRCQFKRLFIDEGLMLHTGCVNFLVAMSLCDVAYVYGDTQQ
P03586 TMVSFMMNFGKSTRCQFKRLFIDEGLMLHTGCVNFLVAMSLCEIAYVYGDTQQ
TOMV        SFLMNYGKGARCQFKRLFIDEGLMLHTGCVNFLVEMSLCDIAYVYGDTQQ
PPMV        SFLMNYGRGP-CQYKRLFLDEGLMLHPGCVNFLVGMSLCSEAFVYGDTQQ
TMGMV       SLLMH---PKPRSHKRLFIDEGLMLHTGCVNFLVLISGCDIAYIYGDTQQ
TMV OB      SFLMNLGKGPVCQFKRLFVDEGLMLHPGCVYFLVKLSLCNEAFVFGDTQQ
ORSV        SFLMH---LKPKTYNKLFIDEGLMLHTGCVNFLIALSHCREAMVFGDTEQ
TVCV        SFLMH---PSRRVFKRLFIDEGLMLHTGCVNFLLLLSQCDVAYVYGDTKQ
CR-TMV      SFLMH---PSRRVFKRLFIDEGLMLHTGCVNFLLLLSQCDVAYVYGDTQQ
RMV-SH      SFLMH---PPKRVFKRLFIDEGLMLHTGCVNFLTLLSHCDVAYVYGDTQQ
CRMV        SFLMH---PPKRVFKRLFIDEGLMLHTGCVNFLMLLSHCDVAYVYVDTQQ
TMV-CG      SFLMH---PPKREFKRLFIDEGLMLHTGCVNFLTLLSHCEVAYVYGDTQQ
CGMMV       SFVMN---RKIFKFDAVYVDEGLMVHTGLLNFALKISGCKKAFVFGDAKQ
CGMMV-W     SFVMN---RKIFKFDAVYVDEGLMVHTGLLNFALKISGCKKAFVFGDAKQ
CFMMV       SFVMN---KKPFTFKTLWVDEGLMVHTGLLNFCVNIAKVKEVRIFGDTKQ
YCGMMV      SFVMN---KKPFTFKTLWVDEGLMVHTGLLNFCVNIAKVKEVKIFGDTKQ
SHMV        SFVMN---RKPGKFKTLWVDEGLMVHPGLINFCINISCVSSVYIFGDRKQ


            251
TMV KR      IPYINRVSGFPYPAHFAKLEVDEVETRRTTLRCPADVTHYLNRRYEGFVM
TMV-RAK     IPYINRVSGFPYPAHFSKLEVDEVETRRTTLRCPADVTHYLNRRYEGFVV
P03586 TMVIPYINRVSGFPYPAHFAKLEVDEVETRRTTLRCPADVTHYLNRRYEGFVM
TOMV        IPYINRVTGFPYPAHFAKLEVDEVETRRTTLRCPADVTHFLNQRYEGHVM
PPMV        IPYINRVATFPYPKHLSQLEVDAVETRRTTLRCPADITFFLNQKYEGQVM
TMGMV       IPFINRVQNFPYPKHFEKLQVDEVEMRRTTLRCPGDVNFFLQSKYEGAVT
TMV OB      IPYINRVQNFPFPQHFSKLIVDETEKRRTTLRCPVDVTHFLNQCYDGAVT
ORSV        IPFINRVANFPYPKHFGHTCLHRREVRRLSLRCPADVTHFMNSKYDGKFL
TVCV        IPFICRVANFPYPAHFAKLVADEKEVRRVTLRCPADVTYFLNKKYDGAVM
CR-TMV      IPFICRVANFPYPAHFAKLVADEKEVRRVTLRCPADVTYFLNKKYDGAVM
RMV-SH      IPFICRVANFPYPSHFAKLVVDEKEDRRVTLRCPADVTYFLNTRYDGSVM
CRMV        IPFICRVANFPYPAHFAKLVVDEKEDRRVTLRCPADVTYFLNQKYDGSVL
TMV-CG      IPFICRVANFPYPKHFAKLVVDEKEDRRVTLRCPADVTFFLNKKYDGAVL
CGMMV       IPFINRVMNFDYPKELRTLIVDNVERRYVTHRCPRDVTSFLNTIYKAAVA
CGMMV-W     IPFINRVMNFDYPKELRTLIVDNVERRYVTHRCPRDVTSFLNTIYKAAVA
CFMMV       IPFINRVMNFDYPLELRKIIVDTVEKRYTSKRCPRDVTHYLNEVYSSPVC
YCGMMV      IPFINRVMNFDYPLELKKIIVDDVEKRYTSKRCPRDVTHYLNEVYAAPVT
SHMV        IPFINRVMNFSIPDNLAKLYYDEIVSRDTTKRCPLDVTHFLNSVYEKRVM


            301
TMV KR      STSSVKKSVSQEMVGGAAVINP-ISKPLHGKILTFTQSDKEALLSRGYS-
TMV-RAK     STSSVKKSVSQEMVSGAAVINP-ISKPLHGKILTFTQSDKEALLSRGYS-
P03586 TMVSTSSVKKSVSQEMVGGAAVINP-ISKPLHGKILTFTQSDKEALLSRGYS-
TOMV        CTSSEKKSVSQEMVSGAASINP-VSKPLKGKILTFTQSDKEALLSRGYA-
```

```
PPMV        CTSSVTRSVSHEVIQGAAVMI   VSKPLKGKVITFTQSDKSLLLSRGYE-
TMGMV       TTSTVQRSVSSEMIGGKGVLNS-VSKPLKGKIVTFTQADKFELEEKGYK-
TMV OB      TTSKTQRSVGLEVVGGAAVMNP-VTKPLKGKIVTFTQSDKLTMLSRGYQ-
ORSV        CTNDVIRSVDAEVVRGKGVFNP-KSKPLKGKIITFTQSDKAELNERGYEE
TVCV        CTSAVERSVKAEVVRGKGALNP-ITLPLEGKILTFTQADKFELLEKGYK-
CR-TMV      CTSAVERSVKAEVVRGKGALNP-ITLPLEGKILTFTQADKFELLEKGYK-
RMV-SH      CTSSVERSVSAEVVRGKGALNP-ITLPLEGKILTFTQADKFELLDKGYK-
CRMV        CTSSVERSVSAEVVRGKGALNP-ITLPLEGKILTFTQADKFELLDKGYK-
TMV-CG      CTSSVERSVSAEVVRGKGALNP-ITLPLEGKILTFTQADKFELLDKGYK-
CGMMV       TTSPVVHSVKAIKVSGAGILRP-ELTKIKGKIITFTQSDKQSLIKSGYN-
CGMMV-W     TTSPVVHSVKAIKVSGAGILRP-ELTKIKGKIITFTQSDKQSLIKSGYN-
CFMMV       TTSPVVHSVTTKKIAGVGLLRP-ELTALPGKIITFTQNDKQTLLKAGYA-
YCGMMV      TSSAVVHSVSQKKIAGVGLLRP-ELTSLEGKIITFTQSDKQTLLKAGYE-
SHMV        SYSNVQRSLECKMISGKAKINDYRSILAEGKLLTFTQEDKEYLLKAGFK-


            351                    .
TMV KR      -----DVHTVHEVQGETYSDVSLVRLTPTPVSIIAGDSPHVLVALSRHTC
TMV-RAK     -----EVHTVHEVQGETYSDVSLVRLTPTPISIIAGDSPHVLVALSRHTC
P03586 TMV-----DVHTVHEVQGETYSDVSLVRLTPTPVSIIAGDSPHVLVALSRHTC
TOMV        -----DVHTVHEVQGETYADVSLVRLTPTPVSIIARDSPHVLVSLSRHTK
PPMV        -----DVHTVHEVQGETFEDVSLVRLTPTPVGIISKQSPHLLVSLSRHTR
TMGMV       -----NVNTVHEIQGETFEDVSLVRLTATPLTLISKSSPHVLVALTRHTK
TMV OB      -----DVNTVHEIQGETYEEVSLVRLTPTPIHIISRESPHVLVGLTRHTR
ORSV        VSTFGEINTVHEIQGETFEDVSVVRLTPTALELISKSSPHVLVALTRHTK
TVCV        -----DVNTVHEVQGETYEKTAIVRLTSTPLEIISSASPHVLVALTRHTT
CR-TMV      -----DVNTVHEVQGETYEKTAIVRLTSTPLEIISRASPHVLVALTRHTT
RMV-SH      -----DVNTVHEVQGETYEKTAIVRLTATPLEIISRASPHVLVALTRHTT
CRMV        -----DVNTVHEVQGETYEKTAIVRLTATPLEIISRASPHVLVALTRHTT
TMV-CG      -----DVNTVHEVQGETYEKTAIVRLTATPLEIISRASPHVLVALTRHTT
CGMMV       -----DVNTVHEIQGETFEETAVVRATPTPIGLIARDSPHVLVALTRHTK
CGMMV-W     -----DVNTVHEIQGETFEETAVVRATPTPIGLIARDSPHVLVALTRHTK
CFMMV       -----DVNTVHEVQGETYEETSVVRATATPIGLISRKSPHVLVALSRHTK
YCGMMV      -----DVNTVHEVQGETYECTSVVRATATPIGLISRKSPHVLVALSRHTK
SHMV        -----DVNTVHEAQGETYRDVNLIRVTATPLTIVSAGSPHVTVALSRHTN


            401
TMV KR      SLKYYTVVMDPLVSIIRDLEKLSSYLLDMYKVDA
TMV-RAK     SLKYYTVVMDPLVSIIRDLEKLSSYLLDMYKVDA
P03586 TMVSLKYYTVVMDPLVSIIRDLEKLSSYLLDMYKVDA
TOMV        SLKYYTVVMDPLVSIIRDLERVSSYLLDMYKVDA
PPMV        SIKYYTVVLDAVVSVLRDLECVSSYLLDMYKVDV
TMGMV       SFKYYTVVLDPLVQIISDLSSLSSFLLEMYMVEA
TMV OB      CFKYYTVVLDPLVKLVRDLECVSNFLLDVYMVDS
ORSV        SFKYYCVVLDPLVKVCSDLSKVSDFILDMYKVDA
TVCV        CCKYYTVVLDPMVNVISEMEKLSNFLLDMYRVEA
CR-TMV      RCKYYTVVLDPMVNVISEMEKLSNFLLDMYRVEA
RMV-SH      RCKYYTVVLDPMVNVISELGKLSNFLLEMYKVES
CRMV        RCKYYTVVLDPMVNVISELGKLSNFLLEMYKVES
TMV-CG      RCKYYTVVLDPMVNVISEMEKLSNFILDMYKVES
CGMMV       AMVYYTVVFDAVTSIIADVEKVDQSILTMFATTV
CGMMV-W     AMVYYTVVFDAVTSIIADVEKVDQSILTMFATTV
CFMMV       AMTYYTVTVDPVSCIIADLEKVDQSILSMYASVA
YCGMMV      TMTYYTVTVDPVSCIIADLEKVDQSILSMYATVA
SHMV        RFVYYTVVPDVVMTTVQKTQCVSNFLLDMYAVAY
```

Tobamovirus RNA dependent RNA p⸍ .nerase

A three-dimensional structure of a RNA-dependent RNA polymerase, that encoded by poliovirus, has been reported by <u>Hansen et al</u>. The alignment used for tree construction is enhanced below by the amino acid sequence of the poliovirus RdRP aligned to the tobamoviral RdRp's. A 3D line is provided that identifies the helices (upper case Roman) and beta-structure elements (numerals) described in that report. The footnote line refers to notes at the bottom that relate to functional or structural comments.

```
                 1
TMV-vul     --MQFYYDKCLPGNSTMMNNFD---AVTMRLTDISLNVKDCILDMSKSVA
TMV-Rak     --MQFYYDKCLPGNSTMMNNFD---AVTMRLTDISLNVKDCILDMSKSVA
TMV-WANG    --MQFYYDKCLPGNSTMMNNFD---AVTMRLTDISLNVKDCILDMSKSVA
TOMV-L      --MQFYYDKCLPGNSTLLNNYD---AVTMKLTDISLNVKDCILDMSKSVA
TMV-KR      --MQFYYDKCLPGNSTMMNNFD---AVTMRLTDISLNVKDCILDMSKSVA
PMMV        --MQYYYDKCLPGNSTILNEYD---AVTMQIRENSLNVKDCVLDMSKSVP
TMGMV       PDLQFYYDVCLPGNSTILNKYD---AVTMRLRDNSLNVKDCVLDFSKSIP
ORSV        --MQFYYDTLLPGNSTILNEYD---AVTMNLRENNLNVKDCTIDFSKSVS
TVCV        --MQFYYDALLPGNSTILNEFD---AVTMNLRDISLNVKDCRIDFSKSVQ
CR-TMV      --MQFYNDTLLPGNSTILNEYD---AVTMNLRDISLNVKDCRIDFSKSVQ
RMV-SH      --MQFYYDTLLPGNSTILNEFD---AVTMNLRDISLNVKDCRIDFSKSVQ
CRMV        --MQFYYDTLLPGNSTILNEFD---AVTMNLRDISLNVKDCRIDFSKSVQ
TMV-CG      --MQFYYDTLLPGNSTILNEFD---AVTMNLRDISLNVKDCRIDFSKSVQ
TMV-OB      QDLQFYYDKCLPGNSTVLNEFD---AVTMNCSDISLNVKDCVLDFSKSVP
CGMMV       --MQEFYDRCLPGNSFVLNDFD---AVTMRLRDNEFNLQPCRLTLSNLDP
CGMMV-W     TDMQEFYDRCLPGNSFVLNDFD---AVTMRLRDNEFNLQPCRLTLSNLDP
CFMMV       --MQNFYDACLPGNSFVLNDYD---SVTMRLVDNEINLQPCRLTLSKADP
YCGMMV      TDMQSFYDACLPGNSFVLNDYD---SVTMRLADNEFNLQPCRLTLSKADP
SHMV        --LQYFYDSWLPGNSFVQNNHD---QWSIISSDINLHSEAVRLDMNKRH-
POLIORDRP   GEIQWMRPSKEVGYPIINAPSKTKLEPSAFHY-VFEGVKEPAVLTKNDPR
3D          --------------------------------------------------
Footnote                               ·  11   1
TMV  VUL    AP---KDQIK-PLIPMVRTAAEMPRQTGLLENLVAMIKRNFNAPELSGII
TMV-RAK     AP---KDQIK-PLIPMVRTAAEMPRQTGLLENLVAMIKRNFNAPELSGII
TMV  WANG   AP---KDQIK-PLIPMVRTAAEMPRQTGLLENLVAMIKRNFNAPELSGII
TOMV  L     AP---KDVKP-TLIPMVRTAAEMPRQTGLLENLVAMIKRNFNSPELSGVV
TMV-KR      AP---KDQIK-PLIPMVRTAAEMPRQTGLLENLVAMIKRNFNAPELSGII
PMMV        LP---RESET-TLKPVIRTAAEKPRKPGLLENLVAMIKRNFNSPELVGVV
TMGMV  SPA  MP---KEVKP-CLEPVLRTAAEPPRAAGLLENLVAMIKRNFNAPDLTGTI
ORSV        VP---RQQEE-FFTPVIRTAAERPRSAGLLENLVAMIKRNFNSPDLTGIL
TVCV        LP---KEQPI-FLKPKIRTAAEMPRTAGLLENLVAMIKRNMNAPDLTGTI
CR-TMV      LP---KEQPI-FLKPKIRTAAEMPRTAGLLENLVAMIKRNMNAPDLTGTI
RMV-SH      VP---KERPV-FMKPKLRTAAEMPRTAGLLENLVAMIKRNMNAPDLTGTI
CRMV        VP---KERPV-FMKPKLRTAAEMPRTAGLLENLVAMIKRNMNAPDLTGTI
TMV-CG      LP---RERPI-FMKPKLRTAAEMPRTAGLLENLVAMIKRNMNAPDLTGTI
TMV  OB     LP---RDNTKVPMTPVIRTAAERPRSQGLLENLVAMIKRNFNSPELSGTV
CGMMV       VPALIKNEAQNFLIPVLRTACERPRIPGLLENLVAMIKRNMNTPDLAGTV
CGMMV-W     VPALVKSEAQNFLIPVLRTACERPRIPGLLENLVAMIKRNMNTPDLAGTV
CFMMV       VTESLKMEKKEFLIPLGKTATERPRIPGLLENLIAIVKRNFNTPDLAGSL
YCGMMV      VAESIKLERKNIDKLDLKTATERPRIPGFLENLVAIVKRNFNTPDLAGVL
SHMV        ----IPRTKGEFLRPLLNTAVEPPRIPGLLENLLALIKRNFNAPDLAGQL
POLIORDRP   L----K-TNFEEAIFSKYVGNKITEVDEHMKEAVDHYAGQLMSLDINTEQ
3D          ----------------------------AAAAAAAAAAAAAAAAA------
Footnote
TMV  VUL    DIENTASLVVDKFFDSYLLKE-----KRKPNKNVSLFSRESLNRWLEKQE
TMV-RAK     DIENTASLVVDKFFDSYLLKE-----KRKPNKNVSLFSRESLNRWLEKQE
TMV  WANG   DIENTASLVVDKFFDSYLLKE-----KRKPNKNVSLFSRESLNRWLEKQE
TOMV  L     DIENTASLVVDKFFDSYLLKE-----KRKPNKNFSLFSRESLNRWIAKQE
TMV-KR      DIENTASLVVDKFFDSYLLKE-----KRKPNKNVSLFSRESLNRWLEKQE
PMMV        DIEDTASLVVDKFFDAYLIKE-----KKKP-KNIPLLSRASLERWIEKQE
TMGMV  SPA  DIESTASVVVDKFFDSYFIKK-----EKYTKNIAGVMTKDSMMRWLENRK
ORSV        DIEDTAELVVNKFWDAYIIDE-LSGGNVTPM------TSDAFHRWMAKQE
TVCV        DIEDTASLVVEKFWDSYVDKE-FSGTNEMTM------TRESFSRWLSKQE
```

```
CR-TMV      DIEDTASLVVEKFWDSYIDK1  SGTNEMTM------TRESFSRWLSKQE
RMV-SH      DIEDTASLVVEKFWDAYVVKE-FSGTDGMAM------TRESFSRWLSKQE
CRMV        DIEDTASLVVEKFWDAYVVKE-FSGTDGMAM------TRESFSRWLSKQE
TMV-CG      DIEDTASLVVEKFWDAYVVKE-FSGTDGMAM------TRESFSRWLSKQE
TMV OB      DMENTASVVADRFFDSYFLKDKLSGCSLGDSGGKNIIDRQALIRWMEKQE
CGMMV       DITNMSISIVDNFFSSFVRDE-V---LLDHLDCVRASSIQSFSDWFSCQP
CGMMV-W     DITNMSISIVDNFFSSFVRDE-V---LLDHLDCVRASSIQSFSDWFSCQP
CFMMV       DISSISKGVVDNFFSTFLRDE-Q---LADHLCKVRSLSLESFSAWFDNQS
YCGMMV      DIDTISKSVVDNFFTTFLRDE-Q---LSDHLVRVRSCSLESFSAWFHNQA
SHMV        DYDFLSRKVCDGFFGKLLPPD-VEASELLRLPVDHMYSVQNFDDWLNKQE
POLIORDRP   MCLEDAMYGTDGLEALDLSTS-----AGYPYVAMGKKKRDILN-------
3D          --------------------------------------------------
Footnote
TMV VUL     QVTIGQLADFDFVDLPAVDQYR-HMYKAQPKQKLDTSIQTEYPA-LQTIV
TMV-RAK     RVTIGQLADFDFVDLPAVDQYR-HMIKAQPKQKLDTSIQTEYPA-LQTIV
TMV WANG    QVTIGQLADFDFVDLPAVDQYR-HMIKAQPKQKLDTSIQTEYPA-LQTIV
TOMV L      QVTIGQLADFDFVDLPAVDQYR-HMIKAQPKQKLDLSIQTEYPA-LQTIV
TMV-KR      QVTIGQLADFDFVDLPAVDQYR-HMIKAQPKQKLDTSIQTEYPA-LQTIV
PMMV        KSTIGQLADFDFIDLPAVDQYR-HMIKQQPKQRLDLSIQTEYPA-LQTIV
TMGMV SPA   EVLLDDLANYNFTDLPAIDQYK-HMIKAQPKQKLDLSIQNEYPA-LQTIV
ORSV        KSTIRQLADFDFVDLPAIDQYK-HMIKAQPKQKLDLSPQDEYAA-LQTIV
TVCV        SSTVGQLADFNFVDLPAVDEYK-HMIKSQPKQKLDLSIQDEYPA-LQTIV
CR-TMV      SSTVGQLADFNFVDLPAVDEYK-HMIKSQPKQKLDLSIQDEYPA-LQTIV
RMV-SH      SSTVGQLADFNFVDLPAVDEYK-HMIKSQPKQKLDLSIQDEYPA-LQTIV
CRMV        SSTVGQLADFNFVDLPAVDEYK-HMIKSQPKQKLDLSIQDEYPA-LQTIV
TMV-CG      SSTVGQLADFNFVDLPAVDEYK-HMIKSQPKQKLDLSIQDEYPA-LQTIV
TMV OB      KSTIGQLADYDFVDLPAIDQYR-HIIKSQPKQKLDLSIQSEYPS-LQTIV
CGMMV       TSAVGQLANFNFIDLPAFDTYM-HMIKRQPKSRLDTSIQSEYPA-LQTIV
CGMMV-W     TSAVGQLANFNFIDLPAFDTYM-HMIKRQPKSRLDTSIQSEYPA-LQTIV
CFMMV       TCALGQLSNFDFVDLPPVDVYN-HMIKRQPKSKLDTSIQSEYPA-LQTIV
YCGMMV      TAAMGQLANFDFSDLPPVDMYT-HMIKRQPKSKLDTSIQSEYPA-LQTIV
SHMV        PGVVGQLANWDHIGMPAADQYR-HMIKRTPKAKLDLSIQSEYPA-LQTIV
POLIORDRP   KQTRDTKEMQKLLDTYGINLPLVTYVKDELRSKTKV-EQGKSRLIEASSL
3D          --------------------------------------------------
Footnote
TMV VUL     YHSKKINAIFGPLFSELTRQLLDSVDSSRFLFFTRKTPAQIEDFFGDLDS
TMV-RAK     YHSKKINAIFGPLFSELTRQLLDSVDSSRFLFFTRKTPAQIEDFFGDLDS
TMV WANG    YHSKKINAIFGPLFSELTRQLLDSVDSSRFLFFTRKTPAQIEDFFGDLDS
TOMV L      YHSKKINAIFGPLFSELTRQLLDSIDSSRFLFFTRKTPAQIEDFFGDLDS
TMV-KR      YHSKKINAIFGPLFSELTRQLLDSVDSSRFLFFTRKTPAQIEDFFGDLDS
PMMV        YHSKKINALFGPVFSELTRQLLETIDSSRFMFYTRKTPTQIEEFFSDLDS
TMGMV SPA   YHSKQINGILAG-FSELTRLLLEAFDSKKFLFFTRKTPEQIQEFFSDLDS
ORSV        YHSKQINAIFGPLFAELTRQLLERIDSSKFLFYTRKTPEQIEEFLSDLDS
TVCV        YHSKKINAIFGPMFSELTRMLLERIDSSKFLFYTRKTPAQIEDFFSDLDS
CR-TMV      YHSKKINAIFGPMFSELTRMLLERIDSSKFLFYTRKTPAQIEDFFSDLDS
RMV-SH      YHSKKINAIFGPMFSELTRMLLERIDTSKFLFYTRKTPTQIEEFFSDLDS
CRMV        YHSKKINAIFGPMFSELTRMLLETIDTSKFLFYTRKTPTQIEEFFSDLDS
TMV-CG      YHSKKINAIFGPMFSELTRMLLERIDTSKFLFYTRKTPTQIEEFFSDLDS
TMV OB      YHSKKINALFGPIFSELTRQMLSAIDTSRYLFFTRKTPEQIEEFFSDLDA
CGMMV       YHPKVVNAVFGPVFKYLTTKFLSMVDSSKFFFYTRKKPEDLQEFFSDLSS
CGMMV-W     YHPKVVNAVFGPVFKYLTTKFLSMVDSSKFFFYTRKKPEDLQEFFSDLSS
CFMMV       YHSKLVNAVFGPVFRYLTSEFLSMVDNSKFFFYTRKLRMICKFLFPHFPN
YCGMMV      YHSKLVNAVFGPVFRYLTSEFLSMVDNSKFFFYTRKTPEDLQSFFSTLSA
SHMV        YHSKHVNAVFGPIFSCLTERLLSVVDPLRFKFFTRTTPADLEFFFRDMVV
POLIORDRP   NDSVAMRMAFGNLYAAFHK-------NPGVITGSAVGCDPDLFWSKIPV
3D          ----BBBBB-CCCCCCCCC---------------------DDDDDD
Footnote                  aaaaaaaa
TMV VUL     HVPMDVLELDISKYDKSQNEFHCAVEYEIWRRLGFEDFLGEVWKQGHRKT
TMV-RAK     HVPMDVLELDISKYDKSQNEFHCAVEYEIWRRLGFEDFLGEVWKQGHRKT
TMV WANG    HVPMDVLELDISKYDKSQNEFHCAVEYEIWRRLGLEDFLAEVWKQGHRKT
TOMV L      HVPMDVLELDVSKYDKSQNEFHCAVEYEIWRRLGLEDFLAEVWKQGHRKT
TMV-KR      HVPMDVLELDISKYDKSQNEFHCAVEYEIWRRLGFEDFLGEVWKQGHRKT
PMMV        NVPMDILELDISKYDKSQNEFHCAVEYEIWKRLGLDDFLAEVWKHGHRKT
TMGMV SPA   HVPMDVLELDISKYDKSQNEFHCAVEYEIWKRLGLNEFLAEVWKQGHRKT
```

```
ORSV         TVPMEALVLDISKYDKSQNEI  AVEYFIWEKLGLNGFLEEVWKQGHRKT
TVCV         TQAMEILELDISKYDKSQNEFHCAVEYKIWEKLGIDEWLAEVWKQGHRKT
CR-TMV       TQAMEILELDISKYDKSQNEFHCAVEYKIWEKLGIDEWLAEVWKQGHRKT
RMV-SH       SQAMEILELDISKYDKSQNEFHCAVEYKIWEKLGIDEWLAEVWRQGHRKT
CRMV         SQAMEILELDISKYDKSQNEFHCAVEYKIWEKLGIDDWLAEVWRQGHRKT
TMV-CG       SQAMEILELDISKYDKSQNEFHCAVEYKIWEKLGIDDWLAEVWRQGHRKT
TMV OB       HQPMEVLELDVSKYDKSQNEFHCAVEYEIWKRLGIDEFLAEVWKQGHRKT
CGMMV        HSDYEILELDVSKYDKSQSDFHFSIEMAIWEKLGLDDILAWMWSMGHKRT
CGMMV-W      HSDYEILELDVSKYDKSQSDFHFSIEMAIWEKLGLDDILAWMWSMGHKRT
CFMMV        KQEYEILELDVSKYDKSQNDFHQAVEMLIWERLGLDDILARIWEMGHKKT
YCGMMV       KESYEILELDVSKYDKSQTDFHQAVEMLIWERLGLDDVLARIWEMGHKKT
SHMV         -GDMEILELDISKYDKSQNKFHFEVEMRIWEMLGIDKYIEKVWENGHRKT
POLIORDRP    LMEEKLFAFDYTGYDASLSPAWFEALEMVLEKIGFGDRVDYIDYLNHSHH
3D           D---11111111-EEEE---FFFFFFFFFFFFF--GGGGGG---------
Footnote                  4        6
TMV VUL      TLKDYTAGIKTCIWYQRKSGDVTTFIGNTVIIAACLASMLPME------K
TMV-RAK      TLKDYTAGIKTCIWYQRKSGDVTTFIGNTVIIAACLASMLRME------K
TMV WANG     TLKDYTAGIKTCIWYQRKSGDVTTFIGNTVIIAACLASMLPME------K
TOMV L       TLKDYTAGIKTCLWYQRKSGDVTTFIGNTVIIASCLASMLPME------K
TMV-KR       TLKDYTAGIKTCIWYQRKSGDVTTFIGNTVIIAACLASMLPME------K
PMMV         TLKDYTAGIKTCLWYQRKSGDVTTFIGNTIIIAACLSSMLPME------R
TMGMV SPA    TLKDYIAGIKTCLWYQRKSGDVTTFIGNTVIIAACLGSMLPME------K
ORSV         SLKDYTAGIKTCLWYQRKSGDVTTFIGNTVIIAACLASMIPMD------K
TVCV         TLKDYTAGVKTCLWYQRKSGDVTTFIGNTIIIAACLSSMIPMD------K
CR-TMV       TLKDYTAGIKTCLWYQRKSGDVTTFIGNTIIIAACLSSMIPMD------K
RMV-SH       TLKDYTAGIKTCLWYQRKSGDVTTFIGNTIIIAACLSSMIPMD------K
CRMV         TLKDYTAGIKTCLWYQRKSGDVTTFIGNTIIIAACLSSMIPMD------K
TMV-CG       TLKDYTAGIKTCLWYQRKSGDVTTFIGNTIIIAACLSSMIPMD------K
TMV OB       TLKDYTAGIKTCLWYQRKSGDVTTFIGNTVIIAACMASMLPME------K
CGMMV        ILQDFQAGIKTLIYYQRKSGDVTTFIGNTFIIAACVASMLPLD------K
CGMMV-W      ILQDFQAGIKTLIYYQRKSGDVTTFIGNTFIIAACVASMLPLD------K
CFMMV        HISDFQAGIKTLIYYQRKSGDVTTFIGNTFIIAACVASMVPLS------R
YCGMMV       SISDFQAGIKTVIYYQRKSGDVTTFIGNTFIIAACVASMIPLS------R
SHMV         HLRDYTAGIKTVIEYQRKSGDVTTFIGNTIIIAACLCSILPME------K
POLIORDRP    LYKNKTYCVKGGM----PSGCSGTSIFNSMINNLIIRTLLLKTYKGIDLD
3D           -----------------------HHHHHHHHHHHHHHHHHHHHHHH------
Footnote                  5                  aaaaaa
TMV VUL      IIKGAFCGDDSLLYFPKGCEFPDV-QHSA--NLMWNFEAK-----LFKKQ
TMV-RAK      IIKGAFCGDDSLLYFPKGCEFPDI-QHSV--NLMWNFEAK-----LFKKQ
TMV WANG     IIKGAFCGDDSLLYFPKGCEFPDV-QHSA--NLMWNFEAK-----LFKKQ
TOMV L       LIKGAFCGDDSLLYFPKGCEYPDI-QQAA--NLMWNFEAK-----LFKKQ
TMV-KR       IIKGAFCGDDSLLYFPKGCEFPDV-QHSA--NLMWNFEAK-----LFKKQ
PMMV         LIKGAFCGDDSILYFPKGTDFPDI-QQGA--NLLWNFEAK-----LFRKR
TMGMV SPA    VIKGAFCGDDSVLYFPKGLDFPDI-QSCA--NLMWNFEAK-----LYRKR
ORSV         VIKAAFCGDDSILDIPKGLDLPDI-QSEA--NLMWNFEAK-----LYRKR
TVCV         VIKAAFCGDDSLIYIPKGLDLPDI-QAGA--NLMWNFEAK-----LFRKK
CR-TMV       VIKAAFCGDDSLIYIPKGLDLPDI-QAGA--NLMWNFEAK-----LFRKK
RMV-SH       VIKAAFCGDDSLIYIPKGLDLPDI-QAGA--NLTWNFEAK-----LFRKK
CRMV         VIKAAFCGDDSLIYIPKGLDLPDI-QAGA--NLTWNFEAK-----LFRKK
TMV-CG       VIKAAFCGDDSLIYIPKGLDLPDI-QAGA--NLTWNFEAK-----LFRKK
TMV OB       VIKAAFCGDDSLVYLPKGCELPNI-QSCA--NLMWNFEAK-----LFKKT
CGMMV        CFKASFCGDDSLIYLPKGLEYPDI-QATA--NLVWNFEAK-----LFRKK
CGMMV-W      CFKASFCGDDSLIYLPKGLEYPDI-QATA--NLVWNFEAK-----LFRKK
CFMMV        SFKAAFCGDDSLIYMPPNLEYNDI-QSTA--NLVWNFEAK-----LYKKK
YCGMMV       SFKASFCGDDSLIYMPPGLEYPDI-QATA--NLVWNFEAK-----LFKKR
SHMV         VFKAGFCGDDSIIYLPRNLLYPDI-QSVS--NNMWNFEAK-----LFKKL
POLIORDRP    HLKMIAYGDDVIASYPHEVDASLLAQSGKDYGLTMPADKSAIFETVTWE
3D           222222---333333-----IIIIIIIIIII-4444--------------
Footnote                  44         9 9
TMV VUL      YGYFCGRYVIHHDRGCIVYYDPLKL-ISKLGAKHIKDWEHLEEFRRSLCD
TMV-RAK      YGYFCGRYIIHHDRGCIVYYDPLKL-ISKLGAKHIKDWEHLEEFRRSLCD
TMV WANG     YGYFCGRYVIHHDRGCIVYYDPLKL-ISKLGAKHIKDWEHLEEFRRSLCD
TOMV L       YGYFCGRYVIHHDRGCIVYYDPLKL-ISKLGAKHIKDWDHLEEFRRSLCD
TMV-KR       YGYFCGRYVIHHDRGCIVYYDPLKL-ISKLGAKHIKDWEHLEEFRRSLCD
```

```
PMMV        YGYFCGRYIIHHDRGCIVYYL  KL-ISKLGAKHIKNREHLEEFRTSLCD
TMGMV SPA   YGYFCGRYIIHHDKGAIVYYDPLKL-ISKLGAKHIKDYDHLEELRVSLCD
ORSV        YGYFCARYIIHHDRGAIVYYDPLKL-ISKLGCKHIKSLDHLEEFRMSLCD
TVCV        YGYFCGRYVIHHDRGAIVYYDPLKL-ISKLGCKHIRDVVHLEELRESLCD
CR-TMV      YGYFCGRYVIHHDRGAIVYYDPLKL-ISKLGCKHIRDVVHLEELRESLCD
RMV-SH      YGYFCGRYVIHHDRGAIVYYDPLKL-ISKLGCKHIRDEVHLEELRRSLCD
CRMV        YGYFCGRYVIHHDRGAIVYYDPLKL-ISKLGCKHIRDEVHLEELRRSLCD
TMV-CG      YGYFCGRYVIHHDRGAIVYYDPLKL-ISKLGCKHIRDEVHLEELRRSLCD
TMV OB      YGYFCGRYVIHHDRGAIVYVDPLKI-ISKLGAKHITDKEHLEEFRISLAD
CGMMV       YGYFCGKYIIHHANGCIVYPDPLKL-ISKLGNKSLVGYEHVEEFRISLLD
CGMMV-W     YGYFCGKYIIHHANGCIVYPDPLKL-ISKLGNKSLVGYEHVEEFRISLLD
CFMMV       YGYFCGKYVIHHANGCIVYPDPLKL-ISKLGNKSLESYDHLEEFRISLMD
YCGMMV      YGYFCGKYVIHHSNGCIVYPDPLKL-ISKLGNKSLESYDHLEEFRISLMD
SHMV        HGYFCGRYILRNGRYLRLLPDPLKI-ITKLGCKAIKDWDHLEEFRISMFD
POLIORDRP   NVTFLKRFFRADEKYPFLIHPVMPMKEIHESIRWTKDPRNTQDHVRSLCL
3D          -555--66666-------77777-JJJJJJJJJ----KKKKKKKKKKKKK
Footnote        77                               88  8
TMV VUL     VAVSLNN-CAYYTQLDDAVWEVHKTAPPGSFVYKSLVKYLSDKVLFRSLF
TMV-RAK     VAVSLNN-CAYYTQLDDAVWEVHKTAPPGSFVYKSLVKYLSDKVLFRSLF
TMV WANG    VAVSLNN-CAYYTQLDDAVWEVHKTAPPGSFVYKSLVKYLSDKVLFRSLF
TOMV L      VAESLNN-CAYYTQLDDAVGEVHKTAPPGSFVYKSLVKYLSDKVLFRSLF
TMV-KR      VAVSLNN-CAYYTQLDDAVWEVHKTAPPGSFVYKSLVKYLSDKVLFRSLF
PMMV        VAGSLNN-CAYYTHLNDAVGEVIKTAPLGSFVYRALVKYLCDKRLFQTLF
TMGMV SPA   VACSLGNWCLGFPQLNAAIKEVHKTAIDGSFAFNCVNKFLCDKFLFRTLF
ORSV        VSSSLNN-CALFGQLNDAIAEVHKTAVNGSFAFCSIVKYLSD????????
TVCV        VASNLNN-CAYFSQLDEAVAEVHKTAVGGSFAFCSIIKYLSDKRLFRDLF
CR-TMV      VASNLNN-CAYFSQLDEAVAEVHKTAVGGSFAFCSIIKYLSDKRLFRDLF
RMV-SH      VTSNLNN-CAYFSQLDEAVAEVHKTAVGGAFVYCSIIKYLSDKRLFKDLF
CRMV        VTSNLNN-CAYFSQLDEAVAEVHKTAVGGAFVYCSIIKYLSDKRLFKDLF
TMV-CG      VTSNLNN-CAYFSQLDEAVAEVHKTAVGGAFVYCSIIKYLSDKRLFKDLF
TMV OB      VSKSLNN-CAYYAQLDEAVREVHKTAPPGSFVYKCIVKFLSNRVLFESLF
CGMMV       VAHSLFN-GAYFHLLDDAIHELFPNAGGCSFVINCLCKYLSDKRLFRSLY
CGMMV-W     VAHSLFN-GAYFHLLDDAIHELFPNAGGCSFVINCLCKYLSDKRLFRSLY
CFMMV       VAKPLFN-AAYFHLLDDAIHEYFPSVGGSTFAISSLCKYLSNKQLFGSLF
YCGMMV      VAKPLFN-AAYFHLLDDAIHEYFPSVGGSSFAINSLCKYLSDKWLFRSLF
SHMV        MACEYKN-CFGFDVLESAVKESFPKAEGCNVAFCAIYKFLSNKYLFRTLF
POLIORDRP   LAWHNGE-EEYNKFL----------AKIRSVPIGRALLLPEYSTLYRRWL
3D          KKKK--L-LLLLLLL----------LLLL--MMMM------NNNNNNNNN
Footnote                                         8       0
TMV VUL     ID
TMV-RAK     IN
TMV WANG    ID
TOMV L      LD
TMV-KR      ID
PMMV        LE
TMGMV SPA   LN
ORSV        ??
TVCV        FV
CR-TMV      FV
RMV-SH      FV
CRMV        FV
TMV-CG      FV
TMV OB      F?
CGMMV       ID
CGMMV-W     ID
CFMMV       IK
YCGMMV      AK
SHMV        SD
POLIORDRP   DS
3D          NN
Footnote
```

- Footnotes:
- 1. N-terminal residues interacting with the thumb.
- 4. Three aspartates involved in metal ion binding at the active site.
- 5. Determinant of preference for NTP over dNTP. Could interact with 2' OH of substrate NTP.
- 6. Caps a helical turn
- 7. beta-turn.
- 8. Interaction across interface I
- 9. Interaction across interface I with Arg 456
- 0. See 9.
- a. Extra residues are present between helix H and beta-2 for poliovirus and between helix D and helix C for tobamoviruses. Their sequence similarity (YKGID for polio vs. LDSID for ToMV) suggests that they may serve similar functions in providing part of Interface I.

Return to Home Page
Last Updated:31 May 2001

Tobamovirus Movement Protein

```
                  1
SHMV        SKIST--LLAPEKFVKLSVSDKFKWKAPSRVCSIVQSDTISMTANGR-SL
CGMMV       SKVSVENSLKPEKFVKISWVDKLLPNYFSILKYLSITDFSVVKAQSYESL
CGMMV-W     SKVSVENSLKPEKFVKISWVDKLLPNYFSILKYLSITDFSVVKAQSYESL
C-CGMMV     SSVGVKNVLKPNEFVKLSWVDRILPDMFTVYRYLSVTDYSVIKSKDSECL
CFMMV       SKVGVRNALKPEEFVKITWVDKLLPDAFTILKYLSITDYSVVQSKDYEHL
YCGMMV      SSVGVKNVLKPNEFVKLSWVDRILPDMFTVYRYLSVTDYSVIKSKDSECL
FPMV        VELKEPKQLKVNDFVKMSFADKILPRSLTRLRTVSISETNVVKLSGLGST
TMV-CG      ????MSYEPKVSDFLALTKKEEILPKAFTRLKTVSISTKDVISVKDSESL
CRMV        ????MSYEPKVSDFLALTKKEEILPKALTRLKTVSISTKDVISVKESESL
CR-TMV      ?MSIVSYEPKVSDFLNLSKKEEILPKALTRLKTVSISTKDIISVKESETL
RMV-SH      ????MSYEPKVSDFLALTKKEEILPKALTRLKTVSISTKDVISVKESESL
TVCV        ?MSIVSYEPKVSDFLNLSKKEEILPKALTRLKTVSISTKDIISVKESETL
TMGMV       MAVSLRDTVKISEFIDLSKQDEILPAFMTKVKSVRISTVDKIMAVKNDSL
TMV-OB      ---MSKAIVKIDEFIKLSKSEEVLPSAFTRMKSVRVSTVDKIMAKENDNI
PMMV        MALVVKDDVKISEFINLSAAEKFLPAVMTSVKTVRISKVDKVIAMENDSL
ORSV        MALVLRDSIKISEFINLSASEKLLPSALTAVKSVRISKVDKIISYENDTL
TOMV-L      MALVVKGKVNINEFIDLSKSEKLLPSMFTPVKSVMVSKVDKIMVHENESL
TMV-vul     MALVVKGKVNINEFIDLTKMEKILPSMFTPVKSVMCSKVDKIMVHENESL
TMV-Rak     MALVVKGKVNINEFIDLTKMEKILPSMFTPVKSVMCSKVDKIMVHENESL


               51
SHMV30K      FTFDVLKDVLKHA-EEYTYVDVLGVVLSGQWLLPKGTPGSAEIILLDSRL
CGMMV30K     VPVKLLRGV--DL-TKHLYVTLLGVVVSGVWNVPESCRGGATVALVDTRM
CGMMV-W      VPVKLLRGV--DL-TKHLYVTLLGVVVSGVWNVPESCRGGATVALVDTRM
C-CGMMV      IPVDLLRGV--DL-SKSKYVTLVGVVISGVWTIPENCAGGATVALVDTRM
CFMMV        IPVDLLRGV--DF-SKSKYVTLVGVVISGVWTIPENCAGGATVALVDTRM
YCGMMV       IPVDLLRGV--DL-SKSKYVTLVGVVISGVWTIPENCAGGATVALVDTRM
FPMV         VNLNILKGV--VLNSESKYVTIRGVVISGVWMVPEGGGGGATVTLMDRRM
TMVCG        CDIDLLVNV--PL-DKYRYVGVLGVVFTGEWLVPDFVKGGVTVSVIDKRL
CRMV         CDIDLLVNV--PL-DKYRYVGVLGVVFTGEWLVPDFVKGGVTVSVIDKRL
CRTMV        CDIDLLINV--PL-DKYRYVGILGAVFTGEWLVPDFVKGGVTISVIDKRL
RMV-SH       CDIDLLVNV--PL-DKYRYVGVLGVAFTGEWLVPDFVKGGVTVSVIDKRL
TVCV         CDIDLLINV--PL-DKYRYVGILGAVFTGEWLVPDFVKGGVTISVIDKRL
TMGMVA30K    SDVDLLKGV--KL-VKKGYVCLADLVVSGEWNLPDNCRGGVSVCIVDKRM
TMV OB       SEVDLLKGV--KL-VKNGYVCLVGLVVSGEWNLPDNCRGGVSICLIDKRM
PMMV         SDVNLLKGV--KL-VKDGYVCLAGLVVSGEWNLPDNCRGGVSVCLVDKRM
ORSV 30K     SDIDLLKGV--KL-VENGYVCLAGLVVTGEWNLPDNCKGGVSICLVDKRM
TMVL30K      SEVNLLKGV--KL-IEGGYVCLVGLVVSGEWNLPDNCRGGVSVCMVDKRM
TMVOM30K     SEVNLLKGV--KL-IDSGYVCLAGLVVTGEWNLPDNCRGGVSVCLVDKRM
TMV-RAK      SEVNLLKGV--KL-IDSGYVCLAGLVVTGEWNLPDNCRGGVSVCLVDKRM


               101
SHMV30K       -KGKASVLAVFNCRAATQEFQFLISPGYSLTCADALKKPFEISCNVIDLP
CGMMV30K      HSVAEGTICKFSAPATVREFSVRFIPNYSVVAADALRDPWSLFVRLSNVG
CGMMV-W       HSVAEGTICKFSAPATVREFSVRFIPNYSVVAADALRDPWSLFVRLSNVG
C-CGMMV       SMVDEGTICKFSVAASTRDFMVKLIPNYYVAASDASSKPWSIFVRVSGVR
CFMMV         SLVSEGTICKFSVSAASRDFTVKLIPNYYVTAADASSKPWSLFVRISGVR
YCGMMV        SMVDEGTICKFSVAASTRDFMVKLIPNYYVLASDASSKPWSIFVRVSGVR
FPMV          KGFKNGLVAEFKTRASSRDFQFKFIPNYSMCVDDVKRAPWELFFKLVGVP
TMVCG         ENSKECIIGTYRAAAKDKRFQFKLVPNYFVSVADAKRKPWQVHVRIQNLR
CRMV          ENSKECIIGTYRAAAKDRRFQFKLVPNYFVSVADAKRKPWQVHVRIQNLK
CRTMV         ANSKECVIGTYRAAAKSKRFQFKLVPNYFVSTVDAKRKPWQVHVRIQDLK
MV-SH         ENSRESMIGTYRAAAKDRRFQFKLVPNYFVSTADAKRKPWQVHVRIQNLK
TVCV          VNSKECVIGTYRAAAKSKRFQFKLVPNYFVSTVDAKRKPWQVHVRIQDLK
TMGMVA30K     KRSKEATLGAYHAPACKKNFSFKLIPNYSITSEDAEKHPWQVLVNIKGVA
MV OB         QRHNEATLGSYTTKASKKNFSFKLIPNYSITSQDAERRPWEVMVNIRGVA
MMV           QRDDEATLGSYRTSAAKKRFAFKLIPNYSITTADAERKVWQVLVNIRGVA
RSV 30K       KRANEATLGSYHTSACKKRFTFKIIPNYSVTTADALKGIWQVMTNIRGVE
MVL30K        ERADEATLGSYYTAAAKKRFQFKVVPNYGITTKDAEKNIWQVLVNIKNVK
MVOM30K       ERADEATLGSYYTAAAKKRFQFKVVPNYAITTQDAMKNVWQVLVNIRNVK
```

```
TMV-RAK      ERADEATLGSYYTAAAKKRF   (VVPNYAITTQDAMKNVWQVLVNIRNVK


             151
SHMV30K      VKDGFTPLSVEIACLVQFSNCVITRSLTMKLKE-N--PATRTF---SAEE
CGMMV30K     IKDGFHPLTLEVACLVATTNSIIKKGLRASVVE-SVVSSDQSI---VLDS
CGMMV-W      IKDGFHPLTLEVACLVATTNSIIKKGLRASVVE-SVVSSDQSI---VLDS
C-CGMMV      IKEGFSPLTLEIASLVATTNSILKKGLRVSVLE-SVVGSDASI---NLDT
CFMMV        IKDGFSPLTLEIASLVATTNSILKKGLRVSVIE-SVVGSDASV---SLDT
YCGMMV       IKEGFSPLTLEIASLVATTNSILKKGLRVSVLE-SVVGSDASI---NLDT
FPMV         IEDGYYPLAIEIATLVEQSRTIINHGLRATILKRCDDISDLELPSADLDE
TMVCG        IEAGWQPLALEVVSVAMVTNNVVVKGLREKVIA-VNDPNVEGF-EGVVDD
CRMV         IEAGWQPLALEVVSVAMVTNNVVVKGLREKVIA-VNDPNVEGF-EGVVDD
CRTMV        IEAGWQPLALEVVSVAMVTNNVVMKGLREKVVA-INDPDVEGF-EGVVDE
RMV-SH       IEAGWQPLALEVVSVAMVTNNVVVKGLREKVIA-VNDPNVEGF-EGVVDD
TVCV         IEAGWQPLALEVVSVAMVTNNVVMKGLREKVVA-INDPDVEGF-EGVVDE
TMGMVA 30K   MEEGYCPLSLEFVSICVVHKNNVRKGLRERILS-VTDGSPIELTEKVVEE
TMV OB       MSEGWCPLSLEFVSVCIVHKNNVRKGLREKVTA-VSEDDAIELTEEVVDE
PMMV         MEKGFCPLSLEFVSVCIVHKSNIKLGLREKITS-VSEGGPVELTEAVVDE
ORSV 30K     MEKGFCPLSLEFVSICVVYLNNIKLGLREKILN-VTEGGPTELTEAVVDE
TMVL30K      MSAGYCPLSLEFVSVCIVYKNNIKLGLREKVTS-VNDGGPMELSEEVVDE
TMVOM30K     MSAGFCPLSLEFVSVCIVYRNNIKLGLREKITN-VRDGGPMELTEEVVDE
TMV-RAK      MSAGFCPLSLEFVSVCIVYRNNIKIGLREKITN-VRDGGPMELTEEVVDE


             201
SHMV30K      VDELLGSMTTLRSIEGLRKKKEP
CGMMV30K     LSEKVEPFFDKVPISAAVMARDP
CGMMV-W      LSEKVEPFFDKVPISAAVMARDP
C-CGMMV      VSDKVQPFFDSVPITAAVIARDR
CFMMV        LSEKVQPFFDSVPITASVVSRDR
YCGMMV       VSDKVQPFFDSVPITAAVIARDR
FPMV         SIELVSNSNIVSKRKTHKKGKKR
TMVCG        FVDSVAAFKAVDTFRKKKKRIGG
CRMV         FVDSVAAFKAIDSFRKKKKRIGG
CRTMV        FVDSVAAFKAVDNFKRRKKKVEE
RMV-SH       FVDSVAAFKAIDSFRKKKKKIGG
TVCV         FVDSVAAFKAVDNFRKRKKKVEE
TMGMVA 30K   FVDEVPMAVKLEKVPENKKEMVG
TMV OB       FIEAVPMARRLQNLRKPKYNKEK
PMMV         FIESVPMADRLRKFRNQSKKGSN
ORSV 30K     FVEKVPMAARLKSFRSVNKKKPS
TMVL30K      FMENVPMSVRLAKFRTKSSKRGP
TMVOM30K     FMEDVPMSIRLAKFRSRTGKKSD
TMV-RAK      FMEDVPMSIRLAKFRSRTGKKSV
```

Last Updated:Thu., May 31, 2001

Alignment of tobamovirus coat protei   equences

```
                1

TMV-OM      SYSITTPSQFVFLSSAWADPIELINLCTNALGNQFQTQQARTVVQRQFSE
S34858      SYSITTPSQFVFLSSAWADPIELINLCINALGNQFQTQQARTVVQRQFSE
S34857      SYSITTPSQFVFLSSAWADPIELINLCINALGNQFQTQQARTVVQRQFSE
S34856      SYSITTPSQFVFLSSAWADPIELINLCINALGNQFQTQQARTVVQRQFSE
TMV-ER      SYNITTPSQFVFLSSAWADPLELINLCTNALGNQFQTQQARTVVQRQFSE
TMV-06      SYSITTPSHFVFLSSAWADPIELINLCTNALGNQFQTQQARTVVQRQFSE
TMV-vul     SYSITTPSQFVFLSSAWADPIELINLCTNALGNQFQTQQARTVVQRQFSE
TMV-DA      SYSITSPSQFVFLSSVWADPIELLNVCTSSLGNQFQTQQARTTVQQQFSE
ToMV-L      SYSITSPSQFVFLSSVWADPIELLNVCTNSLGNQFQTQQARTTVQQQFSE
ToMV-Kr     SYTVSSANQLVYLGSVWADPLELQNLCTSALGNQFQTQQARTTVQQQFSD
TMGMV       PYTINSPSQFVYLSSAYADPVQLINLCTNALGNQFQTQQARTTVQQQFAD
TMV-OB      PYTVTSPSQLVYFGSVWADPITFIDLCTVALGNQFQTQNARTTVQQQFSD
PMMV        AYTVSSANQLVYLGSVWADPLELQNLCTSALGNQFQTQQARTTVQQQFSD
PkMMV       PYTVSSPNQLVYFGSVWADPIALIDLCTVSLGNQFQTQNARTTVQQQFSD
ORSV        SYTITDPSKLAYLSSAWADPNSLINLCTNSLGNQFQTQQARTTVQQQFAD
ORSV-F      SYTITDPSKLAYLSSAWADPNSLINLCTNSLGNQFQTQQARTTVQQQFAD
CR-TMV      SYNITNPNQYQYFAAVWAEPIPMLNQCISALSQSYQTQAARDTVRQQFSN
TVCV        SYNITNPNQYQYFAAVWAEPIPMLNQCMSALSQSYQTQAARDTVRQQFSN
RMV         SYNITNSNQYQYFAAVWAEPTPMLNQCVSALSQSYQTQAGRDTVRQQFAN
HRMV.GER    SYNITNSNQYQYFAAVWAEPTPMLNQCVSALSQSYQTQAGRDTVRQQFAN
HRMV.JAP    SYNITNSNQYQYFAAVWAEPTPMLNQCVSALSQSYQTQAGRDTVRQQFAN
WASABI      SYNITNSNQYQFFAAVWAEPIAMLNQCVSALSQSYQTQAARDTVRQQFSN
TMV-CG      SYNITSSNQYQYFAAMWAEPTAMLNQCVSALSQSYQTQAARDTVRQQFSN
CRMV        VYNITSSNQYQYFAAMWAEPTAMLNQCVSALSQSYQTQAARDTVRQQFSN
RMV-SH      VYNITSSNQYQYFAAMWAEPTAMLNQCVSALSQSYQTQAARDTVRQQFSN
RMV-SH      SYNITSSNQYQYFAAMWAEPTAMLNQCVSALSQSYQTQAARDTVRQQFSN
RMV-CAB     SYNITSSNQYQYFAAMWAEPQAMLNQCVSALSQSYQTQAARDTVRQQFSN
CGMMV       AYNPITPSKLIAFSASYVPVRTLLNFLVASQGTAFQTQAGRDSFRESLSA
CGMMV-W     AYNPITPSKLIAFSASYVPVRTLLNFLVASQGTAFQTQAGRDSFRESLSA
C-CGMMV     SYSTSGIRSLPAFAKSFYPFYDVYNLLVSAQGGALQTQNGKDILRESLTG
CFMMV       SYSTSGLRSLPAYTKSFCPYYALYDLLVSAQGGALQTQNGKDILRDSING
YCGMMV      SYSISSFRSLPAYTKSFYPFIEFYNLLVSSQGGALQTQNGKDISRESLNG
KGMMV       SYSTSGIRSLPAFAKSFYPFYDVYNLLVSAQGGALQTQNGKDILRESLTG
ZGMMV       PYSTSGIRSLPAFSKSFFPYLELYNLLITNQGAALQTQNGKDILRESLVG
SHMV        AYSIPTPSQLVYFTENYADYIPFVNRLINARSNSFQTQSGRDELREILIK


                50

TMV-OM      VWKPSPQVTVRFPD-SD-FKVYRYNAVLDPLVTALLGAFDTRNRIIEVEN
S34858      VWKPSPQVTVRFPD-SD-FKVYRYNAVLDSLVTALLGAFDTRNRIIDVEN
S34857      VWKPSPQVTVRFPD-SD-FKVYRYNAVLDPLVTALLGAFDTRNRIIDVEN
S34856      VWKPSPQVTVRFPD-SD-FKVYRYNAVLDPLVTALLGAFDTRNRIIDVEN
TMV-ER      VWKPSPQVTVRFPD-RD-FKVYRYNAVLDPLVTALLGAFDTRNRIIEVEN
TMV-06      VWKPSPQVTVRFPD-RD-FKVYRYNAVLDPLVTALLGAFDTRNRIIEVEN
TMV         VWKPSPQVTVRFPD-SD-FKVYRYNAVLDPLVTALLGAFDTRNRIIEVEN
TMV-DA      VWKPFPQSTVRFPG-DV-YKVYRYNAVLDPLITALLGTFDTRNRIIEVEN
TOMV-L      VWKPFPQSTVRFPG-DV-YKVYRYNAVLDPLITALLGAFDTRNRIIEVEN
TOMV-KR     VWKTIPTATVRFPA-TG-FKVFRYNAVLDSLVSALLGAFDTRNRIIEVEN
TMGMV       AWKPVPSMTVRFPA-SD-FYVYRYNSTLDPLITALLNSFDTRNRIIEVDN
TMV-OB      LFKTVPTRTNRFNDGENGFRVFRYNSTLDPLISALMNSFDTRNRIIEVDN
PMMV        VWKTIPTATVRFPA-TG-FKVFRYNAVLDSLVSALLGAFDTRNRIIEVEN
PKMMV       LFKTVPTRTIRFSDGENGFRVFRYNSTLDPLITALLNSFDTRNRIIETEN
ORSV        VWQPVPTLTSRFPAGAGYFRVYRYDPILDPLITFLMGTFDTRNRIIEVEN
ORSV-F      VWQPVPTLASRFPAGAGYFRDYRYDPILDPLITFLMGTFDTRNRIIEVEN
CR-TMV      LLSAVVAPSQRFPE-TG-SRVYVNSAVIKPLYEALMKSFDTRNRIIETEE
TVCV        LLSAVVTPSQRFPD-TG-SRVYVNSAVIKPLYEALMKSFDTRNRIIETEE
AAB08579    LLSTIVAPNQRFPD-TG-FRVYVNSAVIKPLYEALMKSFDTRNRIIETEE
HRMV.GER    LLSTIVAPNQRFPD-TG-FRVYVNSAVIKPLYEALMKSFDTRNRIIQTEE
HRMV.JAP    LLSTIVAPNQRFPD-TG-FRVYVNSAVIKPLYEALMKSFDTRNRIIETEE
WASABI      LLSAIVTPNQRFPE-TG-YRVYVNSAVLKPLYEALMKSFDTRNRIIETEE
```

```
TMV-CG      LLSAIVTPNQRFPD-TG-YRV   ISAVLKPLYESLMKSFDTRNRIIETEE
CRMV        LLSAIVTPNQRFPE-AG-YRVҗ ᴛNSAVLKPLYESLMKSFDTRNRIIETEE
RMV-SH      LLSAIVTPNQRFPE-TG-YRVYINSAVLKPLYESLMKSFDTRNRIIETEE
AAD56047    LLSAIVTPNQRFPE-TG-YRMYINSAVLKPLYESLMKSFDTRNRIIETEE
AAD20292    LLSAIVTPNQRFPE-SG-YRVYINSAVLKPLYEALMKSFDTRNRIIETEE
CGMMV       LPSSVVDINSRFPD-AG-FYAFLNGPVLRPIFVSLLSSTDTRNRVIEVVD
CGMMV-W     LPSSVVDINSRFPD-AG-FYAFLNGPVLRPIFVSLLSSTDTRNRVIEVVD
C-CGMMV     LLTSVASLNSRFPA-NE-FFVWSRESRIAAIIDSLLSALDSRNRAIEVEN
CFMMV       LLTTVASPRSRFPA-EG-FFVWSRESRIAAILDSLLSALDSRNRAIEVEN
YCGMMV      LLTSVASPKSRFPA-GE-AFVWSRESRIAAILDSLLSALDSRNRAIEVEN
KGMV        LLTSVASLNSRFPA-NE-FFVWSRESRIAAIIDSLLSALDSRNRAIEVEN
ZGMV        LLSSVASPTSQFPS-GV-FYVWSRESRIAALIDSLFGALDSRNRAIEVEN
SHMV        SQVSVVSPISRFPAEPA-YYIYLRDPSISTVYTALLQSTDTRNRVIEVEN


            100
TMV-OM      QANPTTAETLDATRRVDDATVAIRSAINNLVVELIRGTGSYNRSSFESSS
S34858      QANPTTAETLDATRRVDDATVAIRSAINNLIVELIRGTRSYNRSSFESSY
S34857      QANPTTAETLDATRRVDDATVAIRSAINNLIVELIRGTRSYNRSSFESSS
S34856      QANPMTAETLDATRRVDDATVAIRSAINNLIVELIRGTGSYNRSSFESSS
TMV-ER      QANPTTAETLDATRRVDDATVAIRSAINNLIVELIRGTGSYNRSSFESSS
TMV-06      QANPTTAETLDATRRVDDATVAIRSAINNLMVELIRGTGSYNRSSFESSS
TMV         QANPTTAETLDATRRVDDATVAIRSAINNLIVELIRGTGSYNRSSFESSS
TMV-DA      QQSPTTAETLDATRRVDDATVAIRSAINNLVNELVRGTGLYNQNTFESMS
TOMV-L      QQSPTTAETLDATRRVDDATVAIRSAINNLVNELVRGTGLYNQNTFESMS
TOMV-KR     PQNPTTAETLDATRRVDDATVAIRASISNLMNELVRGTGMYNQALFESAS
TMGMV       QPAPNTTEIVNATQRVDDATVAIRASINNLANELVRGTGMFNQAGFETAS
TMV-OB      PANPNTSEVASATQRVDDATVNIRACINNLMNELVRGTGMMNTASFETVS
PMMV        PQNPTTAETLDATRRVDDATVAIRASISNLMNELVRGTGMYNQALFESAS
PKMMV       PANPNTAEIASATQRVDDATVSIRACINNLMNELARGTGMLNTVSFETIS
ORSV        PQNPTTTETLDATRRVDDATVAIRSAINNLLNELVRGTGMYNQVSFETIS
ORSV-F      PQNPTTTETLDATRRVDDATVAIRSAINNLLNELVRGTGMYNQVSFETMS
CR-TMV      ESRPSASEVRNATQRVDDATVSIRSQIQLLLSELSSGHGYMNRAEFEAL-
TVCV        ESRPSASEVANATQRVDDATVAIRSQIQLLLSELSNGHGYMNRAEFEAL-
 AAB08579   ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGYMNRAEFEAI-
HRMV.GER    QSRPSASQVANATQRVDDATVAIRSQIQLLLNELSNHGGYMNRAEFEAI-
HRMV.JAP    ESRPSASQVADATQRVDDATVAIRSQIQLLLNELSNHGGYMDRAQFEAI-
WASABI      ESRPSASEVANATQRVDDATVAIRSQIQLLLSELSSGHGLMNRAEFEVL-
TMV-CG      ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGLMNRAEFEVL-
CRMV        ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGLMNRAEFEVL-
RMV-SH      ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGLMNRAEFEVL-
AAD56047    ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGLMNRAEFEVL-
AAD20292    ESRPSASEVANATQRVDDATVAIRSQIQLLLNELSNGHGLMNRAEFEVL-
CGMMV       PSNPTTAESLNAVKRTDDASTAARAEIDNLIESISKGFDVYDRASFEAAF
CGMMV-W     PSNPTTAESLNAVKRTDDASTAARAEIDNLIESISKGFDVYDRASFEAAF
C-CGMMV     PSNPSTGEALNATKRNDDASTAAHNDIPLLLAALNDGVGVFDSASFESAF
CFMMV       PSNPSTSEALNATKRNDDASTAAHNDIPQLISALNDGAGVFDRASFESQF
YCGMMV      PSNPSTGEALNATKRNDDASTAAHNDIPLLLAALNDGVGVFDTASFESAF
KGMV        PSNPSTGEALNATKRNDDASTAAHNDIPLLLAALNDGVGVFDSASFESAF
ZGMV        PSNPSTGEALNAVKRNDDASTAAHNDIPQILSALNEGAGVFDRASFESAF
SHMV        STNVTTAEQLNAVRRTDDASTAIHNNLEQLLSLLTNGTGVFNRTSFESAS


            150
TMV-OM      GLVWNSGPA
S34858      GLVWTSGPA
S34857      GLVWTSGPA
S34856      GLVWTSGPA
TMV-ER      GLVWTSGPA
TMV-06      GLVWTSGPA
TMV         GLVWTSGPA
TMV-DA      GLVWTSAPA
TOMV-L      GLVWTSAPA
TOMV-KR     GLTWATTP?
TMGMV       GLVWTTTPA
TMV-OB      NLTWTTTTT
```

```
PMMV        GLTWATTP?
PKMMV       NLTWTTAAT
ORSV        GLTWTSS??
ORSV-F      GLTWTSS??
CR-TMV      -VPWTTAAA
TVCV        -LPWTTAPA
 AAB0857     -LPWTTAPA
HRMV.GER    -LPWTTAPA
HRMV.JAP    -LPWTTAPA
WASABI      -IPWATAPA
TMV-CG      -LPWTTAPA
CRMV        -LPWATAPA
RMV-SH      -LPWATAPA
AAD56047    -LPWATAPA
AAD20292    -LPWTTAPA
CGMMV       SVVWSEATT
CGMMV-W     SVVWSEATT
C-CGMMV     GLTWTASAT
CFMMV       GLVWTAASS
YCGMMV      GLTWTASSS
KGMV        GLTWTASAT
ZGMV        GLVWTAGSS
SHMV        GLTWLVTTT
```

Return to Home Page
Last Updated:Thu., May 31, 2001

Tobamovirus Methyltransferase

```
          1
TMV-KR    MAYTQTATTSALLDTVRGNNSLVNDLAKRRLYDTAVEEFNARDRRPKVNF
TMV-Rak   MAYTQTATTSALLDTVRGNNSLVNDLAKRRLYDTAVDEFNARDRRPKVNF
TMV-vul   MAYTQTATTSALLDTVRGNNSLVNDLAKRRLYDTAVEEFNARDRRPKVNF
TOMV      MAYTQTATSSALLETVRGNNTLVNDLAKRRLYDTAVDEFNARDRRPKVNF
PMMV      MAYTQQATNAALASTLRGNNPLVNDLANRRLYESAVEQCNAHDRRPKVNF
TMGMV     MAHIQSIISNALLESVSGKNTLVNDLARRRMYDTAVEEFNARDRRPKVNF
TMV-OB    MAHIQQSMQGALLDTVRGQNSLVNDLAKRRLYDTAVEEFNAKDRRPKINF
ORSV      MAHFQQTMNTKVTEAGIGRNSLINDLAQRRVYDKPVEELNHRSRRPKVNF
TVCV      MAQFQQTIDMQTLQAAAGRNSLVNDLASRRVYDNAVEELNARSRRPKVHF
CR-TMV    MAQFQQTIDMQTLQAAAGPNSLVNDLASRRVYDNAVEELNARSRRPKVHF
RMV-SH    MAQFQQTVNMQTLQAAAGRNSLVNDLASRRVYDNAVEELNARSRRPKVHF
CRMV      MAQFQQTVNMQTLQAAAGRNSLVNDLASRRVYDNAVEELNARSRRPKVHF
TMV-CG    MAQFQQTVNMQTLQAAAGRNSLVNDLASRRVYDNAVEELNARSRRPKVHF
CGMMV     MANINEQINNQRDAAASGRNNLVSQLASKRVYDEAVRSLDHQDRRPKMNF
CGMMV-W   MANINEQINNQRDAAASGRNNLVSHLASKRVYDEAVRSLDHQDRRPKMNF
CFMMV     MANITQHINDTREAAAAGRNPLVAQLASKRVYDEAVKSLDSQDKRPKVNF
YCGMMV    MANITQQIIDTREAAAAGRNPLIAQLASKRVYDEAVKSLDTQDKRPKVNF
SHMV      ---MSTSTLINKAQTNSCGDVGVVDLLKRKVYDDTVKTMQGLDRRAKYRL

          51
TMV-KR    SKVISEEQTLIATRAYPEFQITFYNTQNAVHSLAGGLRSLELEYLMMQIP
TMV-RAK   SKVISEEQTLIATRAYPEFQITFYNTQNAVHSLAGGLRSLELEYLMMQIP
TMV       SKVISEEQTLIATRAYPEFQITFYNTQNAVHSLAGGLRSLELEYLMMQIP
TOMV      SKVVSEEQTLIATKAYPEFQITFYNTQNAVHSLAGGLRSLELEYLMMQIP
PPMV      LRSISEEQTLIATKAYPEFQITFYNTQNAVHSLAGGLRSLELEYLMMQIP
TMGMV     SKTISEEQTLLVSNAYPEFQITFYNTQNAVHSLAGGLRALELEYLMLQVP
TMV-OB    SKSINEEQTLIVSQAYPEFQITFYNTQLAVHSLAAGLRSLELEYLMMQVP
ORSV      SKVISQEQIIQATNAYAEFEITFYNTQLAVHSMAGGLRALELEYRRMQIP
TVCV      SKAVSTEQTLIATNAYPEFEISFTHTQSAVHSLAGGLRSLELEYLMMQVP
CR-TMV    SKAVSTEQTLIATNAYPEFEISFTHTQSAVHSLAGGFRSLELEYLMMQVP
RMV-SH    SKSVSTEQTLLASNAYPEFEISFTHTQHAVHSLAGGLRTLELEYLMMQVP
CRMV      SKSVSTEQTLLASNAYPEFEISFTHTQQAVHSLAGGLRTLELEYLMMQVP
TMV-CG    SKSVSTEQTLLASNAYPEFEISFTHTQQAVHSLAGGLRTLELEYLMMQVP
CGMMV     SRVVSTEHTRLVTDAYPEFSISFTATKNSVHSLAGGLRLLELEYMMMQVP
CGMMV-W   SRVVSTEHTRLVTDAYPEFSISFTATKNSVHSLAGGLRLLELEYMMMQVP
CFMMV     ARVLTTEQTRKVTESYPEFSISYTASALSVHSLAGGLRYLEGEYLMMQVP
YCGMMV    SRVLSTEQMRVVTENYPEFSVSYTGSALSVHSLAGGLRYLEGEYLMMQVP
SHMV      NQCLGPEQCRTVRGGYPEFQIEFTGASNTSHAMAAGLRGLELEYLYTLVP

          101
TMV-KR    YGSLTYDIGGNFASHLFKGRAYVHCCMPNLDVRDIMRHEGQKDSIELYLS
TMV-RAK   YGSLTYDIGGNFASHLFKGRAYVHCCMPNLDVRDIMRHEGQKDSIEL---
TMV       YGSLTYDIGGNFASHLFKGRAYVHCCMPNLDVRDIMRHEGQKDSIELYLS
TOMV      YGSLTYDIGGNFASHLFKGRAYVHCCMPNLDVRDIMRHEGQKDSIELYLS
PPMV      YGSTTYDIGGNFAAHMFKGRDYVHCCMPNMDLRDVMRHNAQKDSIELYLS
TMGMV     YGSPTYDIGGNFAAHLFKGRDYVHCCMPNLDIRDIMRHEGQKDSIEMYLS
TMV-OB    YGSLTYDIGGNFAAHLFKGRDYVHCCMPNLDLRDIMRHENQKDSVATYLS
ORSV      FGSITYDIAGNFSAHIYKGRDYVHSCMRNLDIRDVARHINQQDTVSSYVA
TVCV      FGSLTYDIGGNFSAHLFKGRDYVHCCMPNLDVRDIARHEGHKEAIYSYVN
CR-TMV    FGSLTYDIGGNFSAHLFKGRDYVHCCMPNLDVRDIARHEGHKEAIHSYVN
RMV-SH    FGSLTYDIGGNFAAHLFKGRDYVHCCMPNLDVRDIARHEGHKEAIFSYLS
CRMV      FGSLTYDIGGNFAAHLFKGRDYVHCCMPNLDVRDIARHEGHKEAIFSYLS
TMV-CG    FGSLTYDIGGNFAAHLFKGRDYVHCCMPNLDVRDIARHEGHKEAIFSYIS
CGMMV     YGSPCYDIGGNYTQHLFKGRSYVHCCNPCLDLKDVARNVMYNDMITQHVQ
CGMMV-W   YGSPCYDIGGNYTQHLFKGRSYVHCCNPCLDLKDVARNVMYNDVVTQHVQ
CFMMV     YGSPVYDIGGNYSQHMLKGRAYVHCCNPCLDLKDIARNEMYKDAIDRYVH
YCGMMV    YGSPCHYIGGNYSQHMLKGRSYVHCCNPCLDLKDVARNEMYKDAIERYVT
SHMV      YGAVSYDIGGNFPAHMMKGRSYVHCCNPALDARDLARNENYRISIENYLS

          151
```

```
TMV-KR     RL--------------ERG'   KTVPNFQKEAFDRYAELPEDAVCHNTF
TMV-RAK    -L--------------DRGG--KTVPNFQKEAFDRYAEFPEDAVCHNTF
TMV        RL--------------ERGG--KTVPNFQKEAFDRYAEIPEDAVCHNTF
TOMV       RL--------------ERGN--KHVPNFQKEAFDRYAEMPNEVVCHDTF
PPMV       KL--------------AQKK--KVIPPYQKPCFDKYTDDPQSVVCSKPF
TMGMV      RL--------------SRSN--KVIPEFQREAFNRYAEAPNEVCCSKTF
TMV-OB     RL--------------KARN--KVLPAFQQEAFQRYSERSDEVVCNNTF
ORSV       RL--------------ERSK--RGLPVFQQSAFNKYMSDPDAVCSDKRF
TVCV       RL--------------KRQQ--RPVPEYQRAAFNNYAENPHFVHCDKPF
CR-TMV     RL--------------KRQQ--RPVPEYQRAAFNNYAENPHFVHCDKPF
RMV-SH     RL-------------DRQK--RPVPEYQRAAFYNYAENPHFVHCDRPF
CRMV       RL-------------DRQR--RPVPEYQRAAFHNYAENPHFVHCDRPF
TMV-CG     RL-------------DRQR--RPVPEYQRAAFNNYAENPHFVHCDRPF
CGMMV      RH--------------KGSCGCRPLPTFQIDAFRRYDSSPCAVTCSDVF
CGMMV-W    RH--------------KGSGGCRPLPTFQIDAFRRYDNSPCAVTCSDVF
CFMMV      KKREAPRSNAWRARAESVQEIKDGRLPSWQIDAFQRYKDCPRAVTCNDVF
YCGMMV     KKRDGPRSVAWRSQAESSQETKFAGLPSWQMDAFRRYHSDPSSVTCPDVF
SHMV       RFEDKSGDYCQWQR---KKPKVSKPLPRYQKACFDRYNEDPEHVTCSETF
```

```
           201
TMV-KR     QTMRHQPMQQSGRVYAIALHSIYDIPADEFGAALLRKNVHTCYAAFHFSE
TMV-RAK    QTCEHQPMQQSGKVYAIALHSIYDIPADEFGAALLRKNVHTCYAAFHFSE
TMV        QTMRHQPMQQSGRVYAIALHSIYDIPADEFGAALLRKNVHTCYAAFHFSE
TOMV       QTCRHSQECYTGRVYÄIALHSIYDIPADEFGAALLRKNVHVCYAAFHFSE
PPMV       QHCEGV-SHCTDKVYAVALHSLYDIPADEFGAALLRRNVHVCYAAFHFSE
TMGMV      QDCRIHPPENSGRRYAVALHSLYDIPVHEFGAALISKNIHVCYAASILAE
TMV-OB     QCCESNRYSSGGRVYAISLHSLYDIPADELGAALLRKNVHTLYAAFHFAE
ORSV       QECSYS-VDLPGKTYAVGLHSIYDIPADEFGAALLRKDVHICYAAFHISE
TVCV       QQCELT-TAYGTDTYAVALHSIYDIPVEEFGSALLRKNVKTCFAAFHFHE
CR-TMV     QQCELT-TANGTDTYAVALLSIYDIPVEEFGSALLRKNVKTCFAAFHFHE
RMV-SH     QQCEIS-TVNGADTYAIALHSIYDIPADEFGAALLRKNVKICYAAFHFHE
CRMV       QQCELS-TVNRWDTYAIALHSIYDIPADEFGAALLRKNVKICYAAFHFHE
TMV-CG     QQCKLS-AANGADTYAIALHSIYDIPVDEFGAALLRKNVKICYAAFHFHE
CGMMV      QECSYD-FGSGRDNHAVSLHSIYDIPYSSIGPALHRKNVRVCYAAFHFSE
CGMMV-W    QECSYD-SGSGGDNHAVSLHSIYDIPYSSIGPALHRKNVRVCYAAFHFSE
CFMMV      QECQYE-HTRRGDRYAVALHSIYDIPFEQIGPALLRKNIKVLFAAFHFSE
YCGMMV     QQCEHE-FSRGGDRYAVALHSIYDVPCEQIGPALLRKNIKVLFAAFHFSE
SHMV       EKCRISPPAERDDIYATSLHSLYDIPYQNLGPALARKRIKVLHAAFHFSE
```

```
           251
TMV-KR     NLLLEDSYVNLDEINACFSRDGDKLTFSFASESTLNYCHSYSNILKYVCK
TMV-RAK    NLLLEDSYVNLDEINACFSRDGDKLTFSFASESTLNYCHSFSNILKYVCK
TMV        NLLLEDSYVNLDEINACFSRDGDKLTFSFASESTLNYCHSYSNILKYVCK
TOMV       NLLLEDSHVNLDEINACFQRDGDRLTFSFASESTLNYSHSYSNILKYVCK
PPMV       NLLLEDSYVSLDDIGAFFSREGDMLNFSFVAESTLNYTHSYSNVLKYVCK
TMGMV      ALLLDQTEVTLNEIGATFKREGDDVSFFFADESTLNYSHKYKNILHYVVK
TMV-OB     ELLLEVSTVELPTIGGIFSRDGDKINFCFSNESTLNYSHSYSNLLKYVCK
ORSV       NLLLETTSAPLDEIGATKYKSGDRLSFFIQNESTLNYEHSYKNVIKYVCK
TVCV       NMLLDCDTVTLDEIGATFQKSGDNLSFFFHNESTLNYTHSFSNIIKYVCK
CR-TMV     NMLLDCDTVTLDEIGATFQRAGDNLSFFFHNESTLNYTHSFSNIIKYVCK
RMV-SH     NMLLDCDSVTLEDIGATFQRAGDKLNFFFHNESTLNYTHSFSNIIKYVCK
CRMV       NMLLDCDSVTLEDIGATFQRAGDKLNFFFHNESTLNYTHSFSNIIKYVCK
TMV-CG     NMLLDCDSVTLEDIGATFQRAGDKLNFFFHNESTLNYTHSFSNIIKYVCK
CGMMV      ALLLGSPVGNLNSIGAQFRVDGDDVHFLFSEESTLHYTHSLENIKLIVMR
CGMMV-W    ALLLGSPVGNLNSIGAQFRVDGDDVHFLFSEESTLHYTHSLENIKLIVMR
CFMMV      ELLLGQSFGALPNIGAFFTVNGDSVEFQFEEESTLHYSHSFQNIRKIVTR
YCGMMV     DLLIGSEFGRLPNVGAFFSVDGDSVNFQFEDESTLHYTHSFSNIRKIVTR
SHMV       DLLLGASEGLLTQIGGTFQRNGDVLTFSFLDESSLIYTHSFRNVFEYVTR
```

```
           301
TMV-KR     TYFPASNREVYMKEFLVTRVNTWFCKFSRIDTFLLYKGVAHKSVDSEQFY
TMV-RAK    TYFPASNREVYMKEFLVTRVNTWFCKFSRIDTFLLYKGVAHKSVDSEQFY
TMV        TYFPASNREVYMKEFLVTRVNTWFCKFSRIDTFLLYKGVAHKSVDSEQFY
TOMV       TYFPASNREVYMKEFLVTRVNTWFCKFSRIDTFLLYKGVAHKGVDSEQFY
```

```
PPMV       TYFPASSREVYMKEFLVTRV!   FCKFSRLDTFVLYRGVYHRGVDKEQFY
TMGMV      SYFPASSRIVYFKEFLVTRVN₁WFCKFTKVDTYILYKSVRQVGCDSDQFY
TMV-OB     TYFPASNRFVYMKEFLITRVNTWFCKFTKLDTYTLYRGVYHRGCDQQEFY
ORSV       TFIPASNRFVYHKEFMCTRVNTWFCKFTKVDTYFLFRGVYTRGEDSEQFY
TVCV       TFFPASQRFVYHKEFLVTRVNTWYCKFTRVDTFTLFRGVYHNNVDCEEFY
CR-TMV     TFFPASQRFVYHKEFLVTRVNTWYCKFTRVDTFTLFRGVYHNNVDCEEFY
RMV-SH     TFFPASQRYVYHKEFLVTRVNTWYCKFTRVDTFTLFRGVYRTSVDSEEFY
CRMV       TFFPASQRYVYHKEFLVTRVNTWYCKFTRVDTFTLFRGVYKTSVDSEEFY
TMV-CG     TFFPASQRYVYHKEFLVTRVNTWYCKFTRVDTFTLFRGVYRSSVDSEEFY
CGMMV      TYFPADDRFVYIKEFMVKRVDTFFFRLVRADTHMLHKSVGHYS-KS----
CGMMV-W    TYFPADDRFVYIKEFMVKRVDTFFFRLVRADTHMLHKSVGHYS-KS----
CFMMV      TYFPASDRVVYVKEFMVKRVDTFFFRMVRVDTHMLHKSVGTYP-VC----
YCGMMV     TFFPASDRVVYVKEFMVKRVDTFFFRMVRVDTHMLHKSVGQYQ-VS----
SHMV       TFFVACNRYAYMKEFRSRRVDTVFCSFIRIDTYCLYRSVFKDC-DEHV-F

           351
TMV-KR     TAMEDAWHYKKTLAMCNSERILLEDSSSVNYWFPKMRDMVIVPLFDISLE
TMV-RAK    TAMEDAWHYKKTLAMCNSERILLEDSSSVNYWFPKMRDMVIIPLFDISL-
TMV        TAMEDAWHYKKTLAMCNSERILLEDSSSVNYWFPKMRDMVIVPLFDISLE
TOMV       KAMEDAWHYKKTLAMCNSERILLEDSSSVNYWFPKMRDMVIVPLFDISLE
PPMV       SAMEDAWHYKKTLAMMNSERILLEDSSSVNYWFPKMKDMVIVPLFDVSLQ
TMGMV      EAMEDAFAYKKTLAMFNTERAIFRDTASVNFWFPKMKDMVIVPLFEGSIT
TMV-OB     SAMEDAWHYKKTLAMLNSERIVLEDHSSVNYWFPKMKDMVIVPLFDVSLE
ORSV       TAMDEAWEYKKTLAMLNSERTIFRDRAAVNFRFPKVKDMVIVPLFDGSVT
TVCV       KAMDDAWHYKKTLAMLNAERTIFKDNAALNFWFPKVRDMVIVPLFDASIT
CR-TMV     KAMDDAWHYKKTLAMLNAERTIFKDNAALNFWFPKVRDMVIVPLFDASIT
RMV-SH     KAMDDAWEYKKTLAMLNSERTIFKDSAAMNFWFPKVRDMVIIPLFDASIT
CRMV       KAMDDAWEYKKTLAMLNSERTIFKDSAAINFWFPKVRDMVIIPLFDASIT
TMV-CG     KAMDDAWEYKKTLAMLNSERTIFKDSAAMNFWFPKVRDMVIIPLFDASIT
CGMMV      ---------KSEYFALNTPPIFQDKATFSVWFPEAK-KVLIPKFELSRF
CGMMV-W    ---------KSEYFALNTPPIFQDKATFSVWFPEAKRKVLIPKFELSRF
CFMMV      ---------ATNYFSLKSSPIFQDKATFSVWFPKAKSKVVIPIFKMQGF
YCGMMV     ---------KNDYYSLKSSPVFQDKATFSVWFPQAKSKVVIPLFEMQGF
SHMV       AAMDDAWEFKKKRVMLEASRPIFNDVAQFNVYFPNAKDKVCLPIFAVKSV

           401
TMV-KR     TSKR--TRKEVLVSKDFVFTVLNHIRTYQAKALTYANVLSFVESIRSRVI
TMV-RAK    ------SRKEVLVSKDFVFTVLNHIRTYQAKALTYANVLSFVESIRSRVI
TMV        TSKR--TRKEVLVSKDFVFTVLNHIRTYQAKALTYANVLSFVESIRSRVI
TOMV       TSKR--TRKEVLVSKDFVYTVLNHIRTYQAKALTYSNVLSFVESIRSRVI
PPMV       NEGKRLARKEVMVSKDFVYTVLNHIRTYQSKALTYANVLSFVESIRSRVI
TMGMV      SKKM--TRSEVIVNRDFVYTVLNHIRTYQAKALTYQNVLSFVESIRSRVI
TMV-OB     TQKR--TKKEVIVSKDFVYTVLNHIRTYQAKALTYNNVLSFVESIRSRVI
ORSV       SGKM--KRREVMVNKDFVYTVLNHIRTYQDKALTYKNVLSFVESIRSRVI
TVCV       TGRM--SRREIMVNKDFVYTVLNHIKTYQAKALTYANVLSFVESIRSRVI
CR-TMV     TGRM--SRREVMVNKDFVYTVLNHIKTYQAKALTYANVLSFVESIRSRVI
RMV-SH     TGRM--SRREVLVNKDFVYTVLNHIKTYQAKALTYANVLSFVESIRSRVI
CRMV       TGRM--SRREVLVNKDFVYTVLNHIKTYQAKALTYANVLSFVESIRSRVI
TMV-CG     TGRM--SRREVLVNKDFVYTVLNHIKTYQAKALTYANVLSFVESIRSRVI
CGMMV      LSGNVKISR-MLVDADFVHTIINHISTYDNKALVWKNVQSFVESIRSRVI
CGMMV-W    LSGNVKISR-MLVDADFVHTIINHISTYDNKALVWKNVQSFVESIRSRVI
CFMMV      FTGSIVAEK-MMIDASFIHTVINHICTYDNKALTWRNVQSFVESIRSRVV
YCGMMV     FSGTLKSKK-MLVDATFIHTVINHICTYDNKALTWRNVQSFVESF-GLGC
SHMV       SGAPVTTRH-ILVEKDFYWTALNHILTYPDGKADFRGVMSFLESIRSRVV

           451
TMV-KR     INGVTARSEWDVDKSLLQSLSMTFYLHTKLAVLKDDLLISKFSLGSKTVC
TMV-RAK    INGVTARSEWDVDKSLLQSLSMTFFLHTKLAVLKDDLLISKFSLGSKTVC
TMV        INGVTARSEWDVDKSLLQSLSMTFYLHTKLAVLKDDLLISKFSLGSKTVC
TOMV       INGVTARSEWDVDKSLLQSLSMTFFLHTKLAVLKDDLLISKFALGPKTVS
PPMV       INGVTARSEWDVDKALLQSLSMTFFLQTKLAMLKDDLVVQKFQVHSKSLT
TMGMV      INGVTARSEWDVDKAILQPLSMTFFLQTKLAALQDDIVMGKFRCLDKTTS
TMV-OB     INGVTARSEWDVDKALLQSMAMTFFLITKLSMLKDELLVSKFTLSAKSVH
ORSV       MNGVTARSEWEVDKSVLQPLSMTFLLQTKLAEAKDQVVLKKFQKIDDTVT
```

```
TVCV       INGVTARSEWDTDKAILGPL˙   FFLITKLGHVQDEIILKKFQKFDRTTN
CR-TMV     INGVTARSEWDTDKAILGPLAₘfFFLITKLGHVQDEIILKKFQKFDRTTN
RMV-SH     INGVTARSEWDTDKAILGPLAMTFFLVTKLSHVQDEIVLKKFQKFDATAK
CRMV       INGVTARSEWDTDKAILGPLAMTFFLVTKLSHVQDEIVLKKFQKFDATAK
TMV-CG     INGVTARSEWDTDKAILGPLAMTFFLVTKLSHVQDEIVLKKFQKFDATTK
CGMMV      VNGVSVKSEWNVPVDQLTDISFSIFPLVKVRKVQIELMSDKVVIEARGLL
CGMMV-W    VNGVSVKSEWNVPVDQLTDISFSIFLLVKVRKVQIELMSDKVVIEARGLL
CFMMV      VNGVSVRSEWDVPVELLTDISFTVFLLVKVKKTQIEIMSDKIVTQPQGLI
YCGMMV     MNGVSVRSEWDVPIEMLCDISFTVFLTVKV-KVQIEIMSEKIVTQPQGLL
SHMV       INGTTTASQWEVDKSQLKDIALSLLLIAKLEKLKISVIEKRIKIERQGLV
```

```
           501
TMV-KR     QHVWDEISLAFGNAFPSVKERLLNRKLIRVAGDALEIRVPDLYVTFHDRL
TMV-RAK    QHVWDEISLAFGNAFPSVKERLLNKKLIRAAGDALEIKVPDLYITFHDRL
TMV        QHVWDEISLAFGNAFPSVKERLLNRKLIRVAGDALEIRVPDLYVTFHDRL
TOMV       QHVWDEISLAFGNAFPSIKERLINRKLIKITENALEIRVPDLYVTFHDRL
PPMV       EYVWDEITAAFHNCFPTIKERLINKKLITVSEKALEIKVPDLYVTFHDRL
TMGMV      ELIWDEVGKFFGNVFPTIKERLVSRKILDVSENALKIKIPDLYVTWKDRF
TMV-OB     EHVWDEIKRGCGNMFPSLKESLLRKKLISGSAEELEIEVPDMYVTFHDRF
ORSV       NLFWKQISDAVGDLFPSIKERLISGGFVKVAEQSLQIKTPDEYITFADKL
TVCV       ELIWTSLCDALMGVIPSVKETLVRGGFVKVAEQALEIKVPELYCTFADRL
CR-TMV     ELIWTSLCDALMGVIPSVKETLVRGGFVKVAEQALEIKIPELYCTFADRL
RMV-SH     ELIWSSLCDALKGVIPSVKETLARGGFVKLAEESLEIKIPELYCTFTDRL
CRMV       ELIWSSLCDALKGVIPSVKETLARGGFVKLAEESLEIKIPELYCTFTDRL
TMV-CG     ELIWTSLCDALKGVIPSVKETLARGGFVKLAEESLEIKIPELYCTFTDRL
CGMMV      RRFADSLKSAVEGLGDCVYDALVQTGWFDTSSDELKVLLPEPFMTFSDYL
CGMMV-W    RRFADSLKSAVEGLGDCVYDALVQTGWFDTSSDELKVLLPEPFMTFSDYL
CFMMV      ERIVQRVSEAFEGCTEAVQKALLTSGWFRTPADDLVLDIPELFMDFHDYL
YCGMMV     LRLAQKVSDAFEGCTATIHAALMSTGWFRCQADELVVEAPELFMDFHDFL
SHMV       SLLKEFLHGLLDEYTQTMAEWVVEKGWVKSVDQVLQVTIPDLVLNFRDHF
```

```
           551
TMV-KR     VTEYKASVDMPALDIRKKMEE--TEVMYNALSELSVLRESDKFDVDVFSQ
TMV-RAK    VAEYKSSVDMPALDIRKRMEE--TEVMYNALSELSVLRESDKFDVDVFSQ
TMV        VTEYKASVDMPALDIRKKMEE--TEVMYNALSELSVLRESDKFDVDVFSQ
TOMV       VSEYKMSVDMPVLDIRKKMEE--TEEMYNALSELSVLKNSDKFDVDVFSQ
PPMV       VKEYKSSVEMPVLDVKKSLEE--AEVMYNALSEISILKDSDKFDVDVFSR
TMGMV      VAEYTKSEELPHLDIKKDLEE--AEQMYDALSELSILKGADNFDIAKFKD
TMV-OB     VAEYKASVEMPTIDISKDLSE--AESYYSALSELSVLENSKDFDLEKFSR
ORSV       VMEYKATEELQHLDISKPLER--AEKYYNALSELSVLKESDEFDITQFKN
TVCV       VLQYKKAEEFQSCDLSKPLEE--SEKYYNALSELSVLENLDSFDLEAFKT
CR-TMV     VLQYKKAEEFQSCDLSKPLEE--SEKYYNALSELSVLENLDSFDLEAFKT
RMV-SH     VLEYKRTEEFQSCDLSKPLEE--SEKYYNALSELSVLENLDSFDLDAFKE
CRMV       VLEYKRTEEFQSCDLSKPLEE--SEKYYNALSELSVLENLGSFDLDAFKE
TMV-CG     VLQYKMAEEFKSCDLSKPLEE--SEKYYNALSELSVLENLDSFDLDGFKE
CGMMV      EGMYEADAKIERESVSELLAS--GDDLFKKIDEIRNNYSGVEFDVEKFQE
CGMMV-W    EGTYEADAKIERESVSELLAS--GDDLFKKIDEIRNNYSGVEFDVEKFQE
CFMMV      SGVFESRMLVLRRRTVEKCFKRFPTSFIRLYRKLCERYSGIEFDLEQVSD
YCGMMV     SAAWEADAKIEAANVESVLDA--SDRLYTTVNELCERYSGIEFDLEKFTD
SHMV       RCEFRTSANVSEVNVSEHLVA--TNEYYAKVSDLVDRNPTLAFDFEKFQD
```

```
           601
TMV-KR     MCQSLEVDPMTAAKVIVAVMSNESGLTLTFERPTEANVALALQDQ-EKAS
TMV-RAK    MCKSLEVDPMTAAKVIVAVMSNESGLTLTFERPTEANVAQALQDQ-EKAS
TMV        MCQSLEVDPMTAAKVIVAVMSNESGLTLTFERPTEANVALALQDQ-EKAS
TOMV       MCQSLEVDPMTAAKVIVAVMSNESGLTLTFEQPTEANVALALQDS-EKAS
PPMV       MCNTLGVDPLVAAKVMVAVVSNESGLTLTFERPTEANVALALQPTITSKE
TMGMV      MCKALDVSPDVAARVIVAVAENRSGLTLTFDKPTEENVAKALKSTASEAV
TMV-OB     MCAINCVNPDIAAKIVVAVLSNESGVTLPFKEPTEGNMAEAMKSGEKDEV
ORSV       LCEEKDIAPDVLAKVIVPIMKNE--LTLPFNNPTPEALSDALSPLPKDLD
TVCV       LCQQKNVDPDMAAKVVVAIMKSE--LTLPFKKPTEEEISESLKPGEGSCA
CR-TMV     LCQQKSVDPDMAAKVVVAIMKCE--LTLPFKKPTEEEISESLKTGEGTSA
RMV-SH     LRQKKNVDPDVAAKVMVAIMNSE--LTLPFKKPTEEEVAEALSGEVVQDE
CRMV       LCQKKNVDPDVAAKVVVAIMNSE--LTLPFKKPTEEEVAEALSGEVVQDE
```

```
TMV-CG       LCQKKNVDPDVAAKVVVAIM    --LTLPFKKPTEEEIAEALSGEVKQSE
CGMMV        FCKELNVNPMLIGHVIEAIFSQKAGVTVTGLGTLSPEMGASVALSSTSVD
CGMMV-W      FCKELNVNPMLIGHVIEAIFSQKAGVTVTGLGTLSPEMGASVALSNTSVD
CFMMV        FCHHHDVNPALVGPVIEAIFSQTAGITVTGLSTKSVEWAAAEALAPTSVD
YCGMMV       FCHHHDVNPSLIGTVIEAIFSQSAGITVTGL----QAKSLEWAAAEALAP
SHMV         YCEKLGVDIDTVTELIDAISTGRAGITLDHTDDKEEQLPRTLAGSSSYLE


             651
TMV-KR       EGALVVTSR-EVEEPSM
TMV-RAK      EGALVVTSR-EVEEPSM
TMV          EGALVVTSR-EVEEPSM
TOMV         DGALVVTSR-DVEEPSI
PPMV         EGSLKIVSS-DVGESSI
TMGMV        VCLEPTSEEVNVNKFSI
TMV-OB       LTLGSQTDNTDLTSKSM
ORSV         MRFSLLKLSTCAPFPSV
TVCV         EHKEVLSLQNDAPFPCV
CR-TMV       EHKDVLSLQNDAPFPCV
RMV-SH       G----LSLSNNAPFPCV
CRMV         G----LRLSNKAPFPCV
TMV-CG       G----LSLSNNAPFPCV
CGMMV        TCEDMDVTEDMEDIVLM
CGMMV-W      TCEDMDVTEDMEDIVLM
CFMMV        MDCDSDDEELEQKFPNL
YCGMMV       VDDDMDCSSDEEDAAPH
SHMV         EEPSDDLVCLSDKAIVN
```

Return to Home Page
Last Updated:Thur., May 31, 2001

- D13367 Gb(84)_vi:MTVCP Tobacco mosaic virus CP gene. 7/94 474bp.
- D13438 Em(40)_vi:MTVGRNA Gb(84)_vi:MTVGRNA Tobacco mosaic virus genomic RNA. 12/93 6,507bp.
- D17458 Em(40)_vi:MTV30KP Gb(84)_vi:MTV30KP Tobacco mosaic virus (TMV) RNA for 30K protein, complete cds. 3/94 795bp.
- D38444 Em(44)_vi:Mtvcg Gb(90)_vi:Mtvcg Tobacco mosaic virus RNA. 10/94 6,303bp.
- J02412 Em(40)_vi:TO30KOM Gb(84)_vi:MTV30KOM tobacco mosaic virus 30k protein gene. 4/90 961bp.
- J02413 Em(40)_vi:TOC30KCP Gb(84)_vi:MTV30KCP tobacco mosaic virus(cowpea strain) 30k & coat protein genes. 4/90 1,800bp.
- J02415 Gb(84)_vi:MTVVCG Tobacco mosaic virus (strain vulgare), complete genome. 9/88 6,395bp.
- L11665 Em(40)_vi:MTVNGHYPE Gb(84)_vi:MTVNGHYPER Tobacco mosaic virus RNA. 8/93 6,506bp
- L35073 Gb(84)n:MTVCOATPRA Tobacco mosaic virus coat protein, complete cds. 8/94 678bp.
- L35074 Gb(84)n:MTVCOATPRO Tobacco mosaic virus coat protein, complete cds. 8/94 680bp.
- M19101 Em(40)_sy:AGVCHY Gb(84)_sy:SYNRMTVCHY Tobacco mosaic virus/calf chymosin recombined mRNA, promoter and 5′ end. 7/89 101bp.
- M19102 Em(40)_sy:AGVLSZ Gb(84)_sy:SYNRMTVLSZ Tobacco mosaic virus/chicken lysozyme recombined mRNA, promotor and 5′ end. 7/89 107bp
- M19103 Em(40)_sy:AGVCAT Gb(84)_sy:SYNRMTVCAT Tobacco mosaic virus/plasmid pJII2 chloramphenicol transferase recombined mRNA, leader and 5′
- M19104 Em(40)_sy:AGVNTP Gb(84)_sy:SYNRMTVNTP Tobacco mosaic virus/plasmid pJII3 neomycin phosphotransferase II recombined mRNA, leader and
- M19105 Em(40)_sy:AGVGUSA Gb(84)_sy:SYNVGUSA Tobacco mosaic virus/plasmid pJII119 beta-glucuronidase recombined mRNA, leader and 5′ end. 7
- M19106 Em(40)_sy:AGVGUSB Gb(84)_sy:SYNVGUSB Tobacco mosaic virus/plasmid pJII139 beta-glucuronidase recombined mRNA, leader and 5′ end. 7
- M24809 Em(40)_vi:TOBMTVGT Gb(84)_vi:MTVGTAMV tobacco mosaic virus RNA, 3′ end. 2/90 72bp.
- M24955 Em(40)_vi:MTVU1RAA Gb(84)_vi:MTVU1RAA Tobacco mosaic virus (U1) omega RNA. 9/90 70bp.
- M24992 Gb(84)_vi:MTVU2RAA Tobacco mosaic virus (U2) omega RNA. 9/89 93bp.
- V01405 Em(40)_vi:TOTMV1 Gb(84)_vi:TOTMV1 Tobacco mosaic virus (TMV) RNA 5′ coding region (nucleotides 69 to 236). 7/89 168bp.
- V01407 Em(40)_vi:TOTMV3 Gb(84)_vi:TOTMV3 Two tobacco mosaic virus genes (viral transport and coat protein). 9/93 961bp.
- V01408 Em(40)_vi:TOTMV4 Gb(84)_vi:TOTMV4 Tobacco mosaic virus genome (variant 1). 7/83 6,395bp
- V01409 Em(40)_vi:TOTMV5 Gb(84)_vi:TOTMV5 Tobacco mosaic virus genome (variant 2). 7/83 6,398bp.
- X00052 Em(40)_vi:TOTMV6 Gb(84)_vi:TOTMV6 Tobacco mosaic virus (TMV) common strain OM. 5′-terminal region. 6/85 275bp.
- X00053 Em(40)_vi:TOTMV7 Gb(84)_vi:TOTMV7 Tobacco mosaic virus tomato (TMV) strain L. 5′-terminal region. 6/85 278bp.

- X02144 Em(40)_vi:TOTMV8 Gb(84)_vi:TOTMV8 Tobacco mosaic virus tomato strain (L) genome. 9/93 6,384bp.
- X66047 Em(40)_vi:TMV54KDA Gb(84)_vi:TMV54KDA Tobacco Mosaic Virus RNA for 54 kDa protein. 6/92 1,566bp.
- X68110 Em(40)_vi:TMVCG Gb(84)_vi:TMVCG Tobacco mosaic virus, complete genome. 10/92 6,395bp.
- X70882 Em(40)_vi:TMVPM2CP Gb(84)_vi:TMVPM2CP Tobacco mosaic virus PM2 mRNA for capsid protein. 7/93 765bp
- X70883 Em(40)_vi:TMVDT1CP Gb(84)_vi:TMVDT1CP Tobacco mosaic virus DT1 mRNA for capsid protein. 7/93 765bp.
- X70884 Em(40)_vi:TMVDT2CP Gb(84)_vi:TMVDT2CP Tobacco mosaic virus DT2 mRNA for capsid protein. 7/93 763bp.
- X70885 Em(40)_vi:TMVDT1GCP Gb(84)_vi:TMVDT1GCP Tobacco mosaic virus DT1G mRNA for capsid protein. 7/93 763bp.
- Z29370 Em(40)_vi:TMVRPTPCP Gb(84)_vi:TMVRPTPCP Tobacco mosaic virus (Crucifer) genomic RNA for RNA-dependent RNA polymerase; 122K protein.
- M25782 Em(43)_vi:Sllcp Gb(89)_vi:Sllcp Satellite tobacco mosaic virus coat protein RNA, complete cds. 11/94 1,058bp.

- J02001 Gb(84)_vi:MAARNA23 alfalfa mosaic virus (Q strain) rna2 3′ end. 2/85 228bp.
- J02003 Em(40)_vi:ALRNA3 Gb(84)_vi:MAARNA3 alfalfa mosaic virus rna 3 35kd protein leader sequence. 4/90 318bp.
- J02005 Gb(84)_vi:MAARNA35 alfalfa mosaic virus (strain 425) rna3 5′ end. 2/85 101bp.
- K02702 Gb(84)_vi:MAACG2Z Alfalfa mosaic virus (strain 425 Leiden) RNA 2 of complete genome. 9/88 2,593bp.
- K02703 Em(40)_vi:ALMRNA3 Gb(84)_vi:MAACG3Z Alfalfa mosaic virus (strain 425 Madison) RNA 3 of complete genome. 4/90 2,037bp
- K03542 Em(40)_vi:MAARNA3L Gb(84)_vi:MAARNA3L Alfalfa mosaic virus RNA 3 encoding viral coat protein, complete.B. 4/90 2,142bp.
- L00161 Gb(84)_vi:MAARNA33 Alfalfa mosaic virus (strain Q) RNA 3, 3′ end. 8/86 230bp
- L00162 Em(40)_vi:ALMAARNA4 Gb(84)_vi:MAARNA4 Alfalfa mosaic virus (strain 425 Leiden) RNA 4 encoding viral coat protein. 5/94 964bp.
- L00163 Em(40)_vi:ALMAACG1Z Gb(84)_vi:MAACG1Z Alfalfa mosaic virus (strain 425 Leiden) RNA 1 of complete genome. 5/94 3,644bp.
- L00164 Gb(84)_vi:MAARNA13 Alfalfa mosaic virus (strain Q) RNA 1. 8/86 226bp.
- M10826 Em(40)_vi:MAARNA01 Gb(84)_vi:MAARNA4AX Alfalfa mosaic virus (A1MV) RNA 4, 3′ terminal fragment 29C. 7/91 91bp.
- M10851 Em(40)_vi:MAARNA4A Gb(84)_vi:MAARNA4A Alfalfa mosaic virus RNA 4, 5′ terminal region. 7/89 74bp.
- M25004 Em(40)_vi:ALMAARNAA Gb(84)_vi:MAARNAA Alfalfa mosaic virus RNA 3 or 4, 3′ end. 4/92 113bp.
- M25005 Em(40)_vi:ALMAARNAB Gb(84)_vi:MAARNAB Alfalfa mosaic virus RNA 2, 3′ end. 4/92 103bp.
- M25006 Em(40)_vi:ALMAARNAC Gb(84)_vi:MAARNAC Alfalfa mosaic virus RNA 1, 3′ end. 4/92 110bp.
- M25452 Em(40)_vi:ALMAARNA1 Gb(84)_vi:MAARNA4D Alfalfa mosaic virus RNA 4 RNA fragment. 4/92 62bp.
- M35975 Em(40)_vi:ALMAARNA Gb(84)_vi:MAARNA1A Alfalfa mosaic virus (strain A1MV-S) 5′ end of RNA-1. 12/90 163bp.
- M35976 Em(40)_vi:ALMAAR01 Gb(84)_vi:MAARNA1B Alfalfa mosaic virus (strain A1MV-B) 5′ end of RNA-1. 12/90 115bp.
- M36389 Em(40)_vi:ALMAAR02 Gb(84)_vi:MAARNA2A Alfalfa mosaic virus (strain A1MV-S) 5′ end of RNA-2. 12/90 108bp.
- M36390 Em(40)_vi:ALMAAR03 Gb(84)_vi:MAARNA2B Alfalfa mosaic virus (strain A1MV-B) 5′ end of RNA-2. 12/90 109bp.
- M36391 Em(40)_vi:ALMAAR04 Gb(84)_vi:MAARNA3B Alfalfa mosaic virus (strain A1MV-S) 5′ end of RNA-3. 12/90 305bp.
- M36392 Em(40)_vi:ALMAAR05 Gb(84)_vi:MAARNA3C Alfalfa mosaic virus (strain A1MV-B) 5′ end of RNA-3. 12/90 290bp.

- <u>M59241</u> Em(40)_vi:ALMAA32K Gb(84)_vi:MAA32KDMP Alfalfa mosaic virus 32 kDa movement protein and coat protein RNA, complete cds. 8/92 2,188bp.
- <u>S55890</u> Em(40)_vi:S55890 Gb(84)_vi:S55890 RNA-3 coat protein homolog, alfalfa mosaic virus RNA-3 32K protein homolog (RNA-2) (raspberry bushy dwarf virus, Genomic RNA, 2231 nt).
- <u>U12509</u> Em(43)_vi:Am12509 Gb(89)_vi:Amu12509 Alfalfa mosaic virus NZ1 RNA4 coat protein mRNA, complete cds. 8/94 876bp.
- <u>U12510</u> Em(43)_vi:Am12510 Gb(89)_vi:Amu12510 Alfalfa mosaic virus NZ2 RNA4 coat protein mRNA, complete cds. 8/94 876bp.
- <u>V00044</u> Em(40)_vi:ALALM1 Gb(84)_vi:ALALM1 5′ end of alfalfa mosaic virus RNA 1. 5/94 61bp.
- <u>V00045</u> Em(40)_vi:ALALM2 Gb(84)_vi:ALALM2 5′ end of alfalfa mosaic virus RNA 2. 5/94 13bp.
- <u>V00046</u> Em(40)_vi:ALALM3 Gb(84)_vi:ALALM3 5′ end of alfalfa mosaic virus RNA 3. 5/94 101bp.
- <u>V00047</u> Em(40)_vi:ALALM4 Gb(84)_vi:ALALM4 Intercistronic junction in alfalfa mosaic virus RNA 3. 5/94 122bp.
- <u>V00048</u> Em(40)_vi:ALALM5 Gb(84)_vi:ALALM5 alfalfa mosaic virus RNA 4 coding for the coat protein. 5/94 881bp.
- <u>V00049</u> Em(40)_vi:ALALM6 Gb(84)_vi:ALALM6 3′ end of alfalfa mosaic virus RNA 1. 7/91 226bp.
- <u>V00050</u> Em(40)_vi:ALALM7 Gb(84)_vi:ALALM7 3′ end of alfalfa mosaic virus RNA 2. 7/91 228bp.
- <u>V00051</u> Em(40)_vi:ALALM8 Gb(84)_vi:ALALM8 3′ end of alfalfa mosaic virus RNA 3. 7/91 230bp.
- <u>V00052</u> Em(40)_vi:ALAM01 Gb(84)_vi:ALAM01 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 8
- <u>V00053</u> Em(40)_vi:ALAM02 Gb(84)_vi:ALAM02 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 6
- <u>V00054</u> Em(40)_vi:ALAM03 Gb(84)_vi:ALAM03 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 4
- <u>V00055</u> Em(40)_vi:ALAM04 Gb(84)_vi:ALAM04 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 4
- <u>V00056</u> Em(40)_vi:ALAM05 Gb(84)_vi:ALAM05 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 4
- <u>V00057</u> Em(40)_vi:ALAM06 Gb(84)_vi:ALAM06 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 3
- <u>V00058</u> Em(40)_vi:ALAM07 Gb(84)_vi:ALAM07 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 3
- <u>V00059</u> Em(40)_vi:ALAM08 Gb(84)_vi:ALAM08 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 3
- <u>V00060</u> Em(40)_vi:ALAM09 Gb(84)_vi:ALAM09 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 2
- <u>V00061</u> Em(40)_vi:ALAM10 Gb(84)_vi:ALAM10 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 2

- <u>V00062</u> Em(40)_vi:ALAM11 Gb(84)_vi:ALAM11 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 25
- <u>V00063</u> Em(40)_vi:ALAM12 Gb(84)_vi:ALAM12 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 19
- <u>V00064</u> Em(40)_vi:ALAM13 Gb(84)_vi:ALAM13 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 19
- <u>V00065</u> Em(40)_vi:ALAM14 Gb(84)_vi:ALAM14 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 18
- <u>V00066</u> Em(40)_vi:ALAM15 Gb(84)_vi:ALAM15 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 18
- <u>V00067</u> Em(40)_vi:ALAM16 Gb(84)_vi:ALAM16 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease A.). 5/94 15
- <u>V00068</u> Em(40)_vi:ALAM17 Gb(84)_vi:ALAM17 Alfalfa mosaic virus RNA 1 fragment. (Obtained after digestion with ribonuclease T1.). 5/94 9
- <u>X00819</u> Em(40)_vi:ALAM19 Gb(84)_vi:ALAM19 Alfalfa mosaic virus (strain S) complete RNA 3 sequence. 9/93 2,055bp.
- <u>X01572</u> Em(40)_vi:A1MVRNA2 Gb(84)_vi:A1MVRNA2 Alfalfa mosaic virus (A1M4) RNA 2. 7/91 2,593bp.
- <u>M28374</u> Em(43)_vi:Maatbts7a Gb(89)_vi:Maatbts7a Alfalfa mosaic virus (clone 143) temperature-sensitive mutant Tbts7 RNA3 (coat protein-encodi
- <u>M28375</u> Em(43)_vi:Maatbts7b Gb(89)_vi:Maatbts7b Alfalfa mosaic virus (clone 112) temperature-sensitive mutant Tbts7 RNA3 (coat protein-encoding), 5′ end fragment.